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Performance and Emission Test of Diesel (100%) and Biodiesel (neem oil 50%) in CI Engine

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Abstract

Biodiesel production is a valuable process which needs a continued study and optimization process because of environmentally advantageous attributes and its renewable nature. In India Neem tree is a widely grown crop, termed as divine tree due to its wide relevance in many areas of study. the present study is intended to consider aspects related to the feasibility of the production of biodiesel from neem oil. The objective of these study was to investigate the effect of the biodiesel produced from high free fatty acid feed stock on engine performance and emission. biodiesel performance and testing is done in CI engine, neem oil was extracted from neem seed by solvent extraction. the neem seeds were first collected from the former and the basic test for suitability of the obtained neem oil was carried out. Biodiesel has been prepared from neem oil by esterification and transesterification. In this work the biodiesel blend of proportion 50:50 (B50) was compared with the 100% diesel in single cylinder 4 stroke water cooled CI engine with the compression ratio of 16 and found that the biodiesel B50 is having higher mechanical efficiency compared to 100% diesel and also the brake thermal efficiency is higher than the pure 100% diesel.

Keywords: Diesel, Biodiesel, Neem oil, Transesterification, Performance, Emission Characteristic.

1. Introduction

It is not a new idea to use biodiesel in engine as alternative fuel it was first used by Rudolph diesel at Paris exposition of 1900[1], Crude oil prices have been increasing rapidly which increases the burden on foreign exchange reserves of importing countries like India, It has severe effect on the economy of oil importing countries, efforts are going all over the world to find alternative automotive fuel due to increase in the demand for petroleum products global warming due to emission of harmful gases, degradation of air quality and fast depletion of supply of fossil fuel noticeable research work has been made to use methyl

ester(bio-diesel) in the place of conventional diesel oil. it has received attention all over the world as an alternative fuel to diesel oil because it has produced from renewable sources such as straight vegetable oil and fried animal fats and oil also a waste cooking oil and fried oil[2], it is eco friendly in nature and referred as green energy source[3,4,5], biodiesel is a renewable diesel fuel substitute that can be made by chemically combining and natural oil or fat with an alcohol such as methanol or ethanol, methanol has been the most commonly used alcohol in commercial production of biodiesel[6], A number of methods are currently available and have been adopted for the production of biodiesel. There are four primary ways to produce biodiesel. pyrolysis, micro-emulsification, dilution and Transesterification[7], Neem is a tree in the family 'Maliaceac' which grows various parts in India it's scientific name 'Azadirachta indicia'. the ever green tree is large, reaching 12 to 18 meters in height with a girth of up to 1.8 to 2.4 meters. the seeds have 40% oil which has high potential for the production of biodiesel. it has a higher molecular weight, viscosity, density, and flash point than diesel fuel neem oil is generally light to dark brown and has a strong odour that is said to combine the odours of peanut and garlic[8]

2. Methodology

A. oil extraction

Fig 2.1. The sample is extracted from solvent extraction of the neem seed, fruit,

Cleaning of neem oil: the first step in obtaining oil from neem for bio diesel to remove the seed coat and husk in a process referred to as de hulling. In developing countries, had objects are used to crack the shell are popular once the nets cracked, the oil bearing seeds are cleaned and dried. Seed cleaning involves the removal of the seed coat and the separation of the chaff.

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Seed drying can be done by placing the seed under the sun or by heating carefully on the fire for a short while. Once this is done, the next step is to begin crucial extraction process.

Transesterification: this is most commonly used process in production of bio diesel. It is most commonly used and important method to reduce the viscosity of vegetable oils.In this process triglyceride reacts with three molecules of alcohol in the presence of a catalyst producing a mixture of fatty acids, alkyl ester and glycerol. The process of removal of all the glycerol and the fatty acids from the vegetable oil in the presence of a catalyst is called transesterification. The bellow fig shows transesterification process

Fig2.2. transesterification setup

B. Properties of biodiesel

Table 2.1 Properties of biodiesel

Prop.	Diesel	Blend50
Flash point(c)	57	58
Fire point(c)	63	60
Density(kg/m)	830	848.4
Viscosity(Cst)	4.3	4.4
CV(kJ/kg)	45700	43170

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3. Experimental setup

Fig 3.1. Engine setup

Table 3.1: Engine specification

Product	VCR Engine test setup 1 cylinder,4 stroke, diesel (comp.)
Engine	Make kirloskar, type 1 cyl. 4 stroke diesel, water cooled power 3.5kw at 1500rpm, stroke 110mm, and bore 87.5mm. 661cc, CR17.5, modified to VCR engine CR 12 to 18. With electric start arrangement, battery and charger
Dynamometer	Type eddy current, water cooled,
Load sensor	Load cell, type strain gauge, range 0-50kg
Compression ration	17.5:1

4. Result and discussion

4.1 Load Vs Brake Thermal Efficiency

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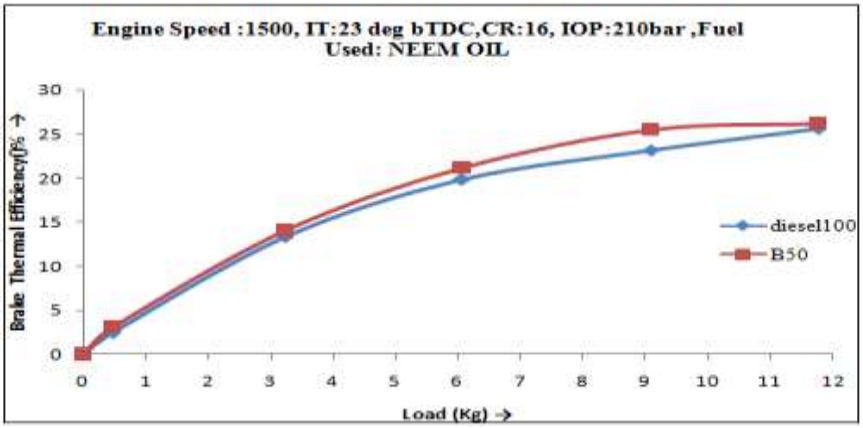

Fig 4.1 Load Vs Brake Thermal Efficiency

Result: as the load increases the brake thermal efficiency for both diesel and biodiesel increases linearly and the biodiesel B50 gives best performance compare to the pure diesel

Discussion: the maximum thermal efficiency for B50 is (0.52%) higher than that of diesel.

4.2 Load Vs Specific Fuel Consumption

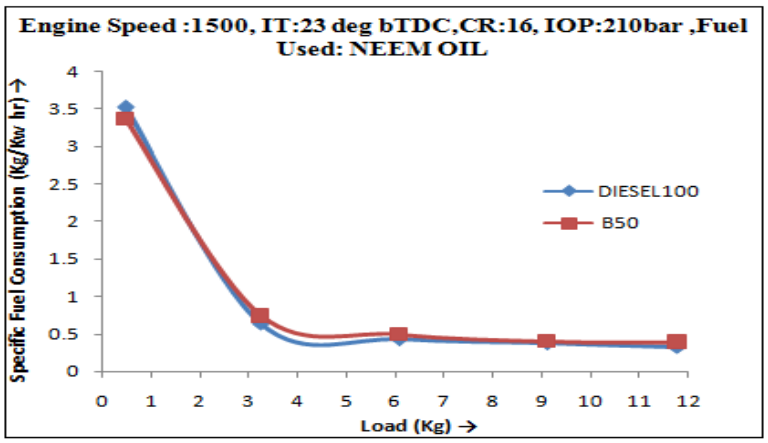

Fig 4.2 Load Vs Specific Fuel Consumption

Result: as the load increases the specific fuel consumption for both diesel and biodiesel decreases linearly.

Discussion: the main reason for this could be that the part load efficiency of any engine is lower than full load. Fuel consumption to produce unit power decreases due to reduction of energy losses.

4.3 Load Vs Volumetric Efficiency

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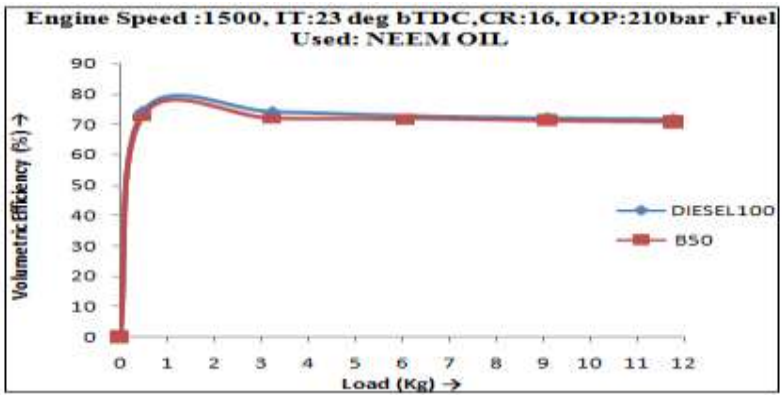

Fig 4.3 Load Vs Volumetric Efficiency

RESULT: From graph diesel and biodiesel (B50) are having similar volumetric efficiency.

DISCUSSION: So volumetric efficiency is just a measure of how good the engine is at sucking in air, and anything that reduces the flow of air into the engine will lower the volumetric efficiency. normally an engine's volumetric efficiency increases with load hits a maximum, then sharply falls.

4.4 Brake Power Vs Brake Thermal Efficiency

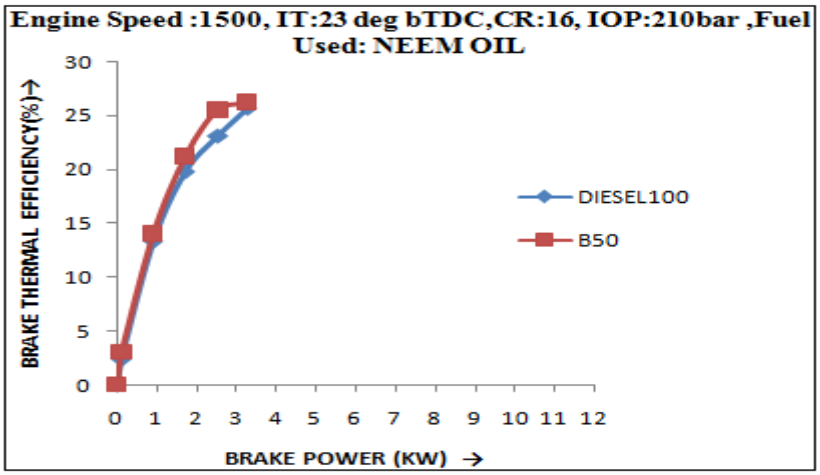

Fig 4.4 Brake Power Vs Brake Thermal Efficiency

RESULT: from the graph we can see that as the brake power increases the brake thermal efficiency for both diesel and biodiesel (B50) increases.

DISCUSSION: the brake thermal efficiency of the blend B50 is higher than diesel at brake power of 3.28 KW. and it gives best performance.

4.5 Brake Power Vs Mechanical Efficiency

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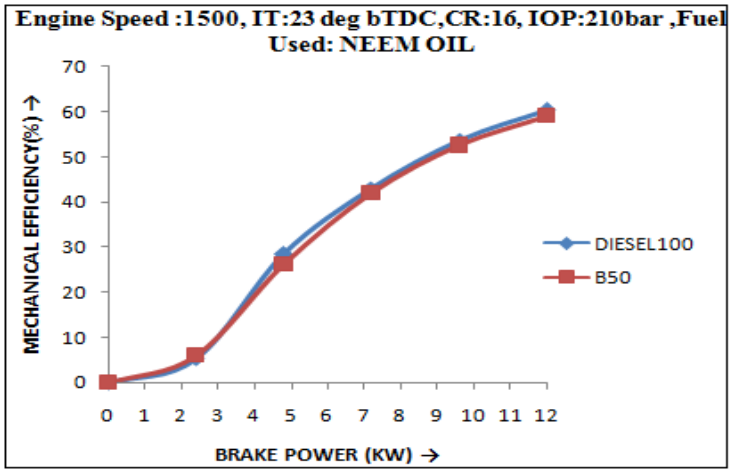

Fig 4.5 Brake Power Vs Mechanical Efficiency

Result: The mechanical efficiency increases as the brake power increase for both pure diesel and biodiesel(B50)

Discussion: the blend B50 produces output nearly same as that of 100% diesel but with difference in brake power.

5. Conclusion

1) Performance, combustion characteristics of bio diesel is well compared with the diesel, the maximum brake thermal efficiency of B50, and diesel are respectively 26.20, and 25.68
2) The brake thermal efficiency for the blend B50 is more as compared to diesel i.e.26.20%
3) The BSFC decreases with an increase in engine load, for biodiesel blends the BSFC are higher than that of diesel fuel, B50 have 0.74 which is higher than diesel fuel
4) From the graph Bp Vs Mechanical Efficiency the bio diesel having lowest mechanical efficiency than the diesel
5) The best blending ratio is 50% diesel and 50% biodiesel I.e.B50 biodiesel which gives the best performance which is closer to diesel fuel
6) Taking analysis of all the above graphs we are finding that the biodiesel (neem oil) is best alternative fuel for CI engine, by comparing biodiesel performance and combustion characteristic we are conclude that B50 biodiesel is gives a best performance with compare to Diesel

References:

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1. Bobade S.N and Khyade V.B. detail study on the properties of pongamia a pinnata (Karanja) for the production of bio fuel, research journal of chemical science, 2012,2(7),16-20
2. Agarwal, A.K., "Bio fuels (alcohols and biodiesel) applications as fuels for internal combination engines", progress in energy combustion science,33,pp233-71,2007
3. Murugeshan, A, umrani, C.J Subramanian, R.J and Neduchezhian, N., "Bio-diesel as an alternative fuel for diesel engines a review ", renewable and sustainable energy review 13, pp53-62, 2009
4. chang, D.Y.Z., and Gerpen, J.H., "fuel properties and engine performance for biodiesel prepared from modified feed stocks", society for automotive engineering, paper no.971684, warrendale, PA,1997
5. Schwab, A.W., Bagby, M.O., and Freedman, B., "Preparation and properties of diesel fuel from vegetable oils ", fuel 66(10), pp1372-1378, 1987
6. An overview of biodiesel and petroleum diesel life cycle, may1998, sheehan, etal. NREL (60pp pdf file)
7. S.P.singh, Dipti singh, biodiesel production through the use of different source and characterization of oils and their esters as the subtitle of diesel: A review, renewable and sustainable energy reviews, 14, 2010, 200-216
8. M.A.Fazal, A.S.M.A, Haseeb and H.H.masjuki(2011) 'biodiesel feasibility study: an evolution of material compatibility, performance', emission and engine durability, renew sustain, energy review, VOL15,2,1314