International Journal on Recent Technologies in Mechanical and Electrical Engineering (IJRMEE) ISSN: 2349-7947
Volume: 2 Issue: 11 021 – 024

Performance Analysis and Investigation of Emissions of C.I. Engine Using Biodiesel and Its Blends

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***Abstract*—** In 1979 due to sudden increase in prices of the petroleum products by the supplying countries, attention was diverted to find out substitute indigenous vegetable oils as substitute fuel to diesel oil. Lot of work is going on different types of vegetable oils. The major advantage of vegetable oils as fuel is that they are non exhaustible and renewable. Since 10 years, researchers are studying on the effects of biodiesel on engine performance and emissions. The use of biodiesel leads to the substantial reduction in PM, HC and CO emissions accompanying with the imperceptible power loss, the increase in fuel consumption and the increase in NOx emission on conventional diesel engines with no or fewer modification. And it favors to reduce carbon deposit and wear of the key engine parts. Therefore, the blends of biodiesel with small content in place of petroleum diesel can help in controlling air pollution and easing the pressure on scarce resources without significantly sacrificing engine power and economy. However, many further researches about optimization and modification on engine, low temperature performances of engine, new instrumentation and methodology for measurements, etc., should be performed when petroleum diesel is substituted completely by biodiesel.
In this report combination of three biodiesels such as CSOME, NOME and OPOME are taken for performance analysis and investigation of exhaust emission of C.I. engine. These three biodiesels are combined to form biodiesel in proportions of 2:1:1 and their blends as B10 and B20 with diesel are taken for performance analysis and investigation of exhaust emissions of C.I. engine. The results show that SFC increases and exhaust gas emission decreases with increase in blend.

Keywords- *biodiesel, Cotton seed oil, Neem oil, Orange peel oil, Performance, Emissions, alternative fuel*

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I. INTRODUCTION

Diesel engine will be the major power source for automobiles in the twenty-first century. To reduce emissions and solve the energy crisis, designing diesel engines with low emission and less energy consumption has always be an objective for researchers across the globe. However, with the development of new technologies, today's diesel engines have better emission characteristics and the less energy consumption compared with its predecessor. But, there is still lot to do on diesel engines aimed to achieve our goal of clean and effective diesel engine. Accordingly, research on a clean burning fuel instead of conventional fuel is advisable, which could not only decrease exhaust gas to a great extent, but, also provide more options of energy sources. The use of alternative fuels for internal combustion engines has attracted a great deal of attention due to fossil fuel crisis. Alternative fuels should be easily available, environment friendly, and techno-economically competitive. Successful alternative fuel should fulfill environmental and energy security needs without sacrificing engine operating performance. Renewable resources offer the opportunity to tap local resources and reduce dependency on fossil energy resources. Most biodiesel oils, particularly of the non-edible type can be used as fuel in diesel engines. One of the promising alternative fuels considered for diesel engine is biodiesel.

Biodiesel fuels are renewable, as the carbon released by the burning of biodiesel fuel is used when the oil crops undergo photosynthesis. Biodiesel also offers the advantage of being able to readily use in existing diesel engines without engine modifications. The alkyl monoester of fatty acids as bio-diesel which was obtained from renewable oil and fats materials by transesterification reaction is a good alternative. Biodiesel can be obtained from raw vegetable oil by transesterification with methanol or ethanol after chemical reactions. Vegetable oils present a very promising alternative to diesel oil since they are renewable and have similar properties as of diesel. Many researchers have studied the use of vegetable oils in diesel engines. This recommends the intensive studies on the use of alternative fuels especially renewable ones like vegetable oils and alcohols. Biodiesels such as Jatropha, Karanja, Sunflower and cottonseed are some of the popular biodiesels currently considered as substitute for diesel.

When biodiesel is used as a substitute for diesel, it is highly essential to understand the parameters that affect the combustion phenomenon which will in turn have direct impact on thermal efficiency and emission. in the present energy scenario lot of efforts is being focused on improving the thermal efficiency of ic engines with reduction in emissions. The problem of increasing demand for high

brake power and the fast depletion of the fuels demand severe controls on power and a high level of fuel economy.

Different properties of orange peel oil and its esters are shown in table.1

Table: - 1 Properties of diesel, Cotton seed oil, Neem oil, Orange peel oil and its esters

Property	Ref. Standard	Reference		Diesel	Blends	
		Unit	Limit	B00	B10	B20
Density	D1448	gm/cc	.800 - .900	0.84	0.84	0.84
C.V	D6751	MJ/Kg	34-45	42.5	42.4	42.1
Cetane no.	D613	…….	41-55	49.5	…..	…..
Viscosity	D445	mm2/sec	3.0-6.0	2.7	……	….
Moisture	D2709	%	0.05 %	NA	NA	NA
Fash point	D93	0C	…..	64	…..	…..
Fire point	D93	0C	…..	71	…..	…..
Ash	D482	%wt	0.1 % Max	0.05	…..	…..
Cloud point	D2500	0C	…..	-6	…..	…..

II. EXPERIMENTAL SET UP

Experimental set up consists of single cylinder, four strokes, and water cooled diesel engine as shown in fig. 1. The set up is computerised.

F1: Fuel flow, F2: Air flow, T1: Inlet water temperature, T2: Outlet water temperature from engine, T3: Inlet water temperature to calorimeter, T4: Outlet water temperature from calorimeter, T5: Exhaust gas temperature at inlet to calorimeter,T6: Exhaust gas temperature at outlet to calorimeter

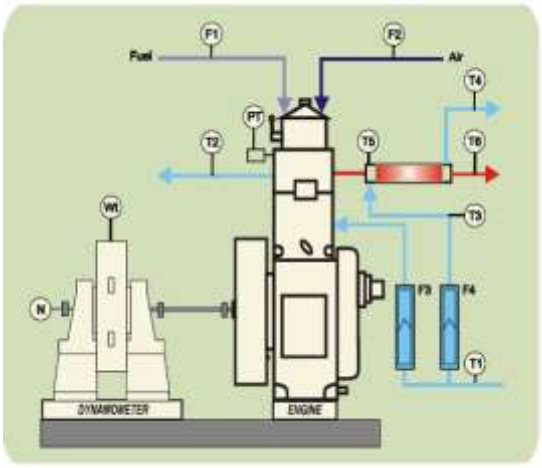


Fig. 1 Experimental set up

Table 2:- Engine Specifications

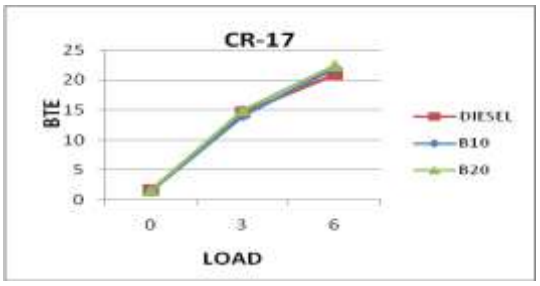
Feature	Description
Make and Model	VCR Engine test setup 1 cylinder, 4 stroke, Diesel (Computerized)
Type of engine	4 stroke, Variable compression diesel engine
No. of cylinder	Single cylinder
Cooling media	Water cooled
Rated capacity	3.5 KW at 1500 rpm
Cylinder diameter	87.5 mm
Stroke length	110 mm
Connecting rod length	234 mm
Compression ratio	12:1-18:1
Orifice diameter	20 mm
Dynamometer	Eddy current dynamometer
Dynamometer arm length	145 mm

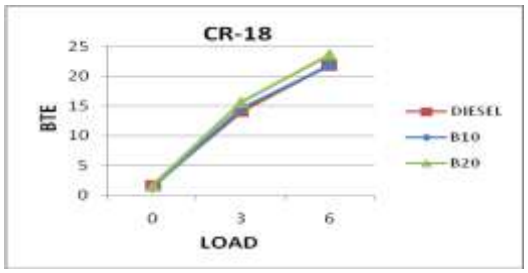
III. EXPERIMENTAL RESULTS

1. Performance Analysis

a) Variation of BTE with load and blend

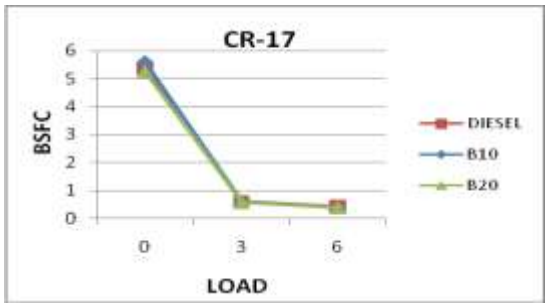
Change in brake thermal efficiency for various blends of NOME, CSOME, OPOME and diesel with change in load is given below. As the load on the engine increases, brake thermal efficiency increases because brake thermal efficiency is the function of brake power and brake power increases as the load on the engine increases.

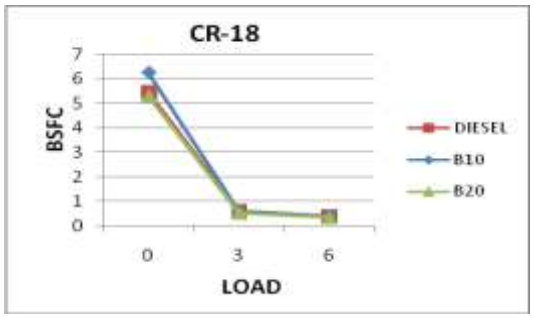




b) Variation of BSFC with load and blend

BSFC for diesel is lowest for almost all loading conditions and decreases continuously with increase in load. BSFC for blends is slightly higher than diesel except for B20 having very close to that of diesel.

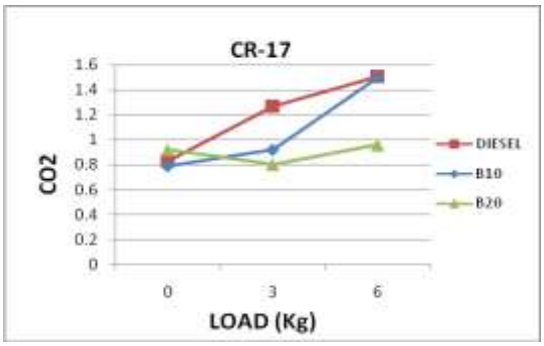


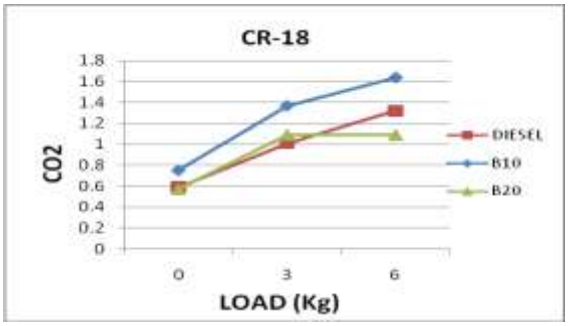


2. Exhaust Gas Emissions

a) Variation of CO_2 with load and blend

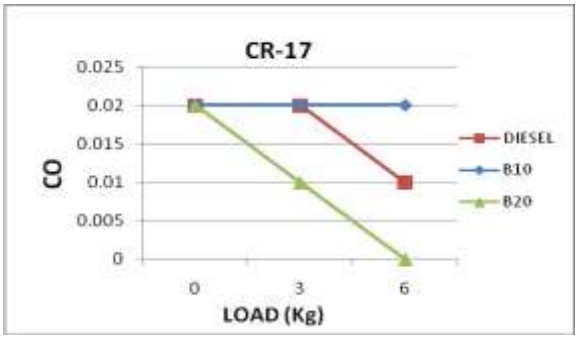
If the engine performs well than defiantly CO emission will be less. In the presence of less oxygen, CO will generate in the cylinder. Biodiesel produce less carbon dioxide than compare to pure diesel because of better combustion because extra oxygen present in the blend. When percentage of blend of biodiesel increases, carbon dioxide decreases because of extra oxygen present in the blend which may lead to better combustion for all blends.

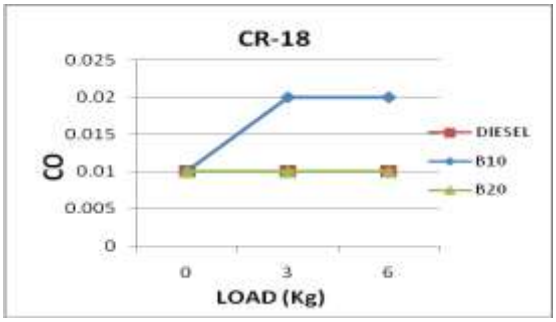




b) Variation of CO with load and blend

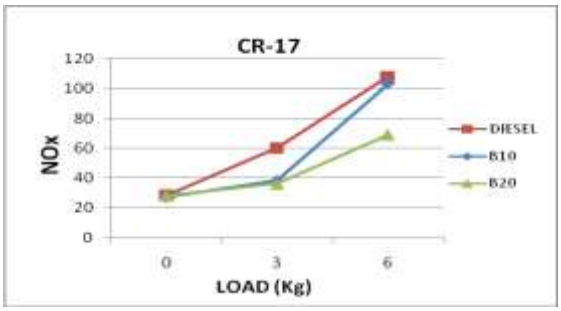
At no load all blends exhibits almost same amount of CO in the engine exhaust which is almost 30% less than that exhibited by diesel. After that amount of CO exhibited by biodiesel starts to increase whereas amount of CO emission by diesel increases. At part loads and full loads, amount of CO emissions less than that emitted by diesel, but B10, B20, B30 it follows same trend and for B40 and B50 it again decreases with load. CO is mainly produced due to incomplete combustion. In case of all blends, there is proper amount of methyl esters present as compared to diesel hence less emission of CO.

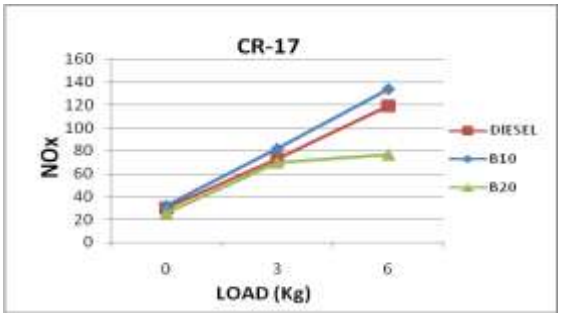




c) Variation of NO_x with load and blend

At higher temperature nitrogen will combined with oxygen and produce the oxides of nitrogen. Biodiesel gives less oxides of nitrogen as compared to pure diesel with increasing blend and load.





IV. CONCLUSION

1. Brake power increases with load and decreases by little amount with increase in blend
2. Indicated power follows same trend as that of diesel for all blends
3. BTE increases with load and blend for all types of blends
4. BSFC decreases as load increases for all blends
5. As compared with diesel for all blends CO_2 decreases with increase in load
6. As compared with diesel for all blends O_2 decreases with increase in load
7. As compared with diesel for all blends CO remains constant with increase in load
8. As compared with diesel for all blends NOx decreases with increase in Blend but increases with load
9. We can conclude that combination of CSOME, NOME and OPOME and its blends can be used as alternate fuel for diesel without modification in CI engine.

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