

Effect of Back Pressure Due to Biodiesel on Engine Life Improvement

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ABSTRACT: Petroleum products resources are limited and their consumption rate is increasing very fast with technological development since the last two decades. The emissions from the usage of these petroleum products pollute the environment considerably. Jatropha oil & Karanja Oil are one of the renewable energy resources which are easily available in India. This study investigates the percentage substitution of jatropha methyl ester & Karanja blends to diesel as fuel for automobiles and other industrial purposes. The study details the analysis of the performance and emission characteristics of the jatropha methyl esters, Karanja and its comparison with petroleum diesel. The exhaust back pressure is the gauge pressure in the exhaust system at the outlet of the exhaust manifold. The term back pressure can be also spelled as one word (backpressure) or using a (back- pressure). It should be noted that the term "back pressure" is counterintuitive and may interfere, with a proper understanding of the exhaust gas flow mechanics. The word back seems to suggest a pressure that is exerted on a fluid against its direction of flow indeed; back pressure definitions of that sort are common in sources of relaxed scientific standards. The tests were carried out on a 3.7 KW single cylinder, direct injection and a water-cooled diesel engine. The fuels used were neat Karanja, jatropha methyl ester, diesel and different blends of the biodiesel with diesel. The experimental result shows that 10% upto 20% of the blend shows better performance with reduced pollution. The analysis shows that Karanja & jatropha methyl ester blended biodiesel is a good substitute for pure diesel.

KEYWORDS: Karanja, Jatropha biodiesel, water-cooled diesel engine, performance, Back Pressure, emission characteristics.

I. INTRODUCTION

In recent years several researches have been made to use vegetable oil, animal fats as a source of Renewable energy known as bio diesel that can be used as fuel in CI engines. Vegetable oils are Alternative fuels for CI engines as they are renewable, biodegradable, non toxic, lower emission compared to diesel fuel. Even though "diesel" is part of its name there is no petroleum in bio-diesel. It is 100% vegetable oil based, that can be blended at any level with petroleum diesel to create a bio diesel.

Internal combustion engine is one of the main users of fossil fuels. Currently, diesel fuel is among the most popular vehicle fuel types. The demand of diesel fuel has been growing constantly during the last two decades. The increase in diesel fuel demand can be explained by the fact that diesel engines are more efficient, use relatively less fuel per engine effective power unit and have a less harmful impact on the environment compared to petrol engines. However, limited reserves of fossil fuels, increasing market prices of mineral fuels and ambient air pollution create problems and impose researchers to investigate a new alternative and renewable energy resource suitable for diesel engine powering. Moreover, the implication of the European Union (EU) Directive 2009/28/EC to use renewable energy in the transport sector in the year 2020 minimum 10% renewable energy. Currently, biodiesel is a widely used biofuel for diesel engines in many countries. Biodiesel generally is derived from vegetable oils and alcohol in presence of catalyst, defined as mono-alkyl esters of a long chain fatty acids. It is considered as renewable, biodegradable, environmental friendly and less toxic fuel in comparison to mineral diesel. The properties of these esters are similar to mineral fuel.

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Rapeseed oil is the main raw materials for the biodiesel production in the EU. The quality of biodiesel in the EU member states is regulated by the EN 14214:2008+A1:2009 standard, which defines the main indicator to be ester content, which depends on biofuel production technology. Fatty acid composition is the indicator, which shows the nature of biodiesel. The purity of this alternative fuel is defined by the free glycerol content, which depends on the manufacturing method as well as product treatment and purification methods.

The advantage of using biodiesel to diesel engines is the higher content of oxygen in its fatty acid composition compared with diesel fuels (Torres-Jimenez et al. 2011). Being an oxygenated fuel, it is environmentally cleaner than petrol diesel with respect to hydrocarbon and particulate matter emissions.

Engine exhaust back pressure is defined as the exhaust gas pressure that, is produced by the engine to overcome the hydraulic resistance of the exhaust system in order to discharge the gases into the atmosphere. The exhaust back pressure is the gauge pressure in the exhaust system at the outlet of the exhaust manifold. The term back pressure can be also spelled as one word (backpressure) or using a hyphen (back- pressure). It should be noted that the term "back pressure" is counter-intuitive and may interfere with a proper understanding of the exhaust gas flow mechanics. The word back seems to suggest a pressure that is exerted on a fluid against its direction of flow indeed; back pressure definition of that sort are common in sources of relaxed scientific standards.

II. RELATED WORK

The engine was started with the neat diesel fuel with constant speed of 1500 rpm and allowed to run for 20 minutes to obtain the steady state condition. The variable load tests were conducted. At each load, air flow rate, fuel flow rate, exhaust gas temperature, oxides of nitrogen, unburned hydrocarbon, carbon monoxide and smoke density were measured. Then the same procedure was repeated with AME20.

Study of Engine Performance has been an important process since the evolution of the engines. In the very early stages, only the external performance was studied with help of loading with a Dynamometer and measuring the parameters like Torque, Output power, Specific Fuel Consumption. For this, in the earlier research, Mechanical Spring and piston type recorders were used. Computerized IC engine Test Rigs with an intent not only to give the students how the testing is done and data is acquired, but to give them a more clear idea about the real time combustion by developing the combustion analysis system. Along with that, one can get all other data like Heat Balance Sheet, Thermal efficiencies, BSFC, Mechanical Efficiency, Air-fuel ratio etc.

A. Main components of system

- Dynamometer :Eddy Current type with computerized torque measuring
- Burette: For measuring the fuel consumption per unit time.
- Manometer: For measuring the air consumption.
- Temperature Indicator: For measuring the temperature at various locations.
- Potentiometer: For loading the dynamometer.
- Engine fitted with a Piezo sensor for Pressure measurement
- Computerized Fuel Flow measurement system
- Computerized Water Flow measurement system

The experimental investigations were conducted in a Kirloskar TV-I DI diesel engine. The specification of the test engine was given in table 2. A single cylinder 4-stroke water cooled diesel engine with 3.2 kW brake power at constant of 1500 rpm was used in this study. The engine was coupled to an eddy current dynamometer with control systems. The engine is equipped with crank angle sensor, piezo-type cylinder pressure sensor, thermocouples to measure the temperature of the water, air and exhaust gas. Di-gas analyzer was used to measure the emissions from the exhaust gas. AVL smoke meter was used to the smoke density from the engine exhaust gas. The schematic view of the experimental setup was shown in the figure

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Sr. No	Parameters	Range value
1)	LOAD (value) ----- X1	40 % , 60 % , 100 %
2)	Compression Ratio (CR) -----X2	14 , 16 ,18
3)	Injection pressure -----X3	P1 P2 P3
4)	Speed -----X4	1500

Table. Parameter & Range Value



Fig. 1 Experimental setup

The performance of an internal combustion engine is mainly studied with the help of combustion and operating characteristics. These characteristics obtained by using diesel, Jatropha and Karanja biodiesel in 4 cylinders, 4 strokes diesel engine with eddy current dynamometer. Performance tests were conducted from no load to full load conditions for diesel, B5, B10 and B20for Jatropha and Karanja Biodiesel.

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Particular	Specification
Type	Single cylinder engine
No. of strokes & cylinder	4 stroke & single cylinder
Fuel	H.S diesel
Rated power	3.5 kW
Speed	1500 RPM
Cylinder diameter	87.5 mm
Stroke Length	110 mm
Connecting Rod length	234 mm
Compression Ratio	12 o 18.1:1

III. BIODIESEL BLENDS

Biodiesel is a domestically produced, renewable fuel that can be manufactured from new and used vegetable oils, animal fats, and recycled restaurant grease. Biodiesel's physical properties are similar to those of petroleum diesel, but the fuel significantly reduces greenhouse gas emissions and toxic air pollutants. It is a biodegradable and cleaner burning alternative to petroleum diesel Biodiesel can be blended and used in many different concentrations. They include B100 (pure biodiesel), B5 (5% biodiesel, 95% petroleum diesel), B10 (10% biodiesel, 90% petroleum diesel), and B20 (20% biodiesel, 80% petroleum diesel).The most common biodiesel blend is B20, which qualifies for fleet compliance under the Energy Policy Act (Epect) of 1992

Blends	Jatropha %	Karanja%	Diesel%
B5	2.5	2.5	95
B10	5	5	90
B20	10	10	80

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IV. EXPERIMENTAL RESULTS

The Images Below are Some Parts of Experimental Setup Which are used to Measure the performance of engine

- a) VCR engine Test Setup
- b) Engine & Calorimeter inlet & outlet detailing for Measuring Temperature
- c) Calorimeter Details for checking the Temperature of Inlet and outlet
- d) Engine Decomposed Lever e) Dynamometer & Water Inlet & Outlet for managing the speed and proper flow of water

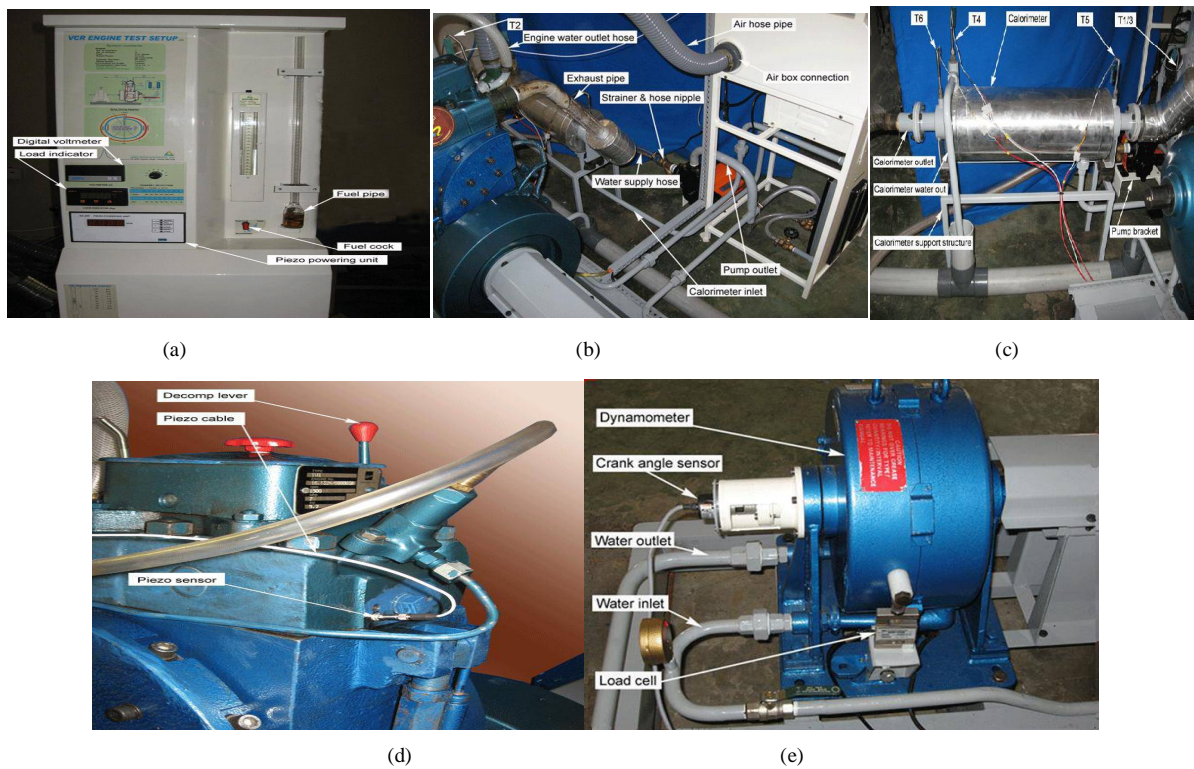


Fig.2. (a) VCR engine test setup (b) engine inlet/outlet detailing (c) Calorimeter Details (d) Engine decomposed lever (e) Image Dynamometer

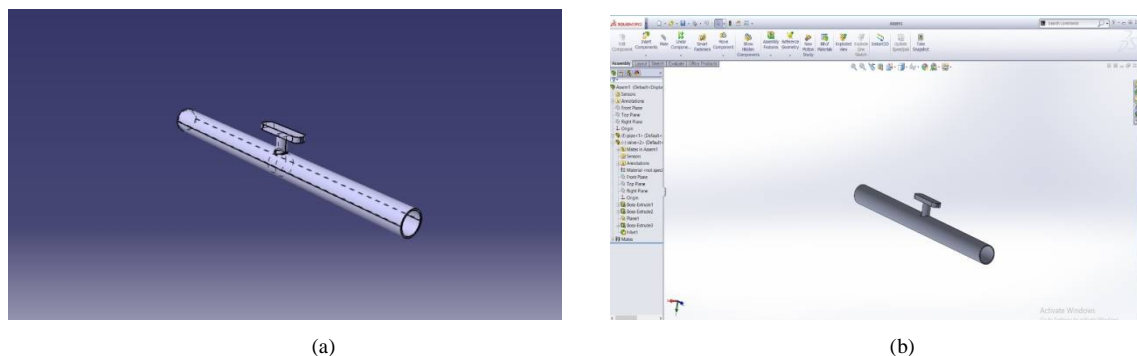


Fig. 3 (a) & (b) Solid Model of exhaust pipe With gate valve

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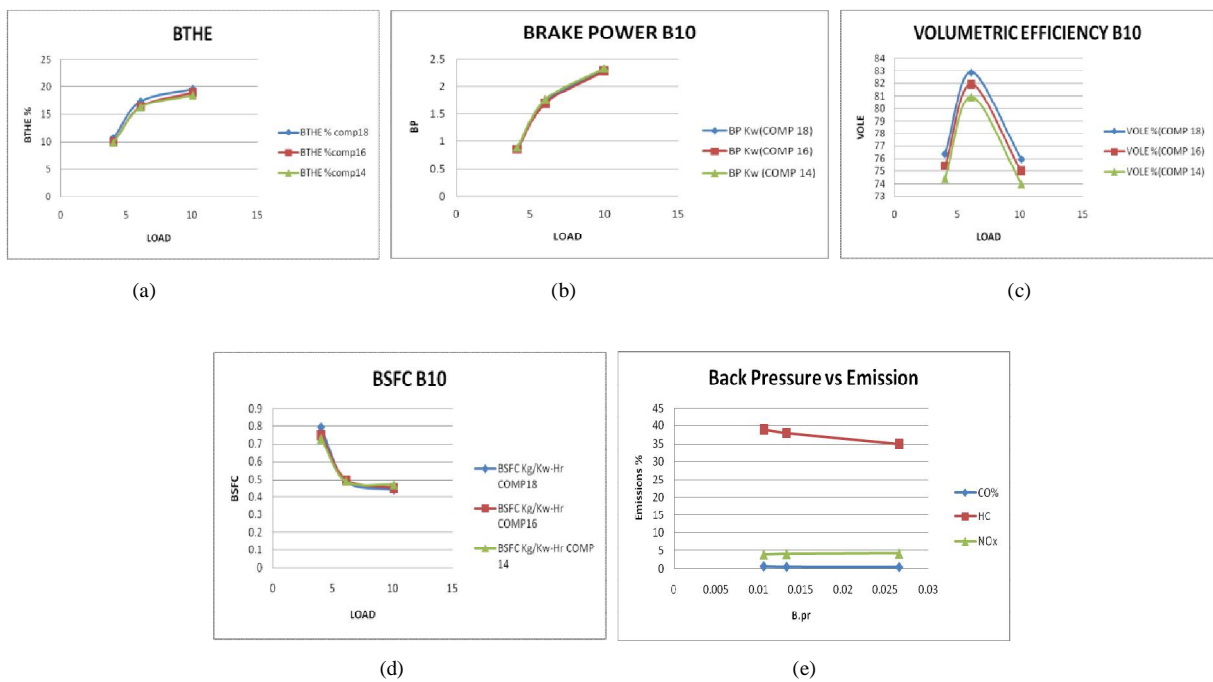
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Solid Model :

Solid model of exhaust pipe with gate valve created in CATIA modeling software with the following design dimensions such as :

Pipe diameter	40mm
Pipe length	600 mm
Valve position	At center of the pipe
Valve closing conditions	80 %

Fig. 3 . (a) & (b) Image Of Solid Exhaust Pipe



For B10 blend, graphs show that Brake power of Karanja and Jatropa increases when load increases but brake power of diesel slightly increases with load. With increase in load, value of B.S.F.C. of Karanja and Jatropa decreases gradually but B.S.F.C of diesel decreases slightly. When the load increases, thermal efficiency of Karanja and Jatropa increases rapidly but thermal efficiency of diesel slightly increases. Volumetric efficiency of Karanja, Jatropa and Diesel increases with increase in Load

Fig. 4 (a) Graph BTHE for B10 (b) Graph Brake Power for B10 (c) Graph Volumetric Efficiency for B10 (d) Graph Brake Specific fuel consumption for B10 (e) Graph Back Pressure vs Emission (B5 , B10 , B20)

VI. CONCLUSION

- Performance of C.I. Engine using Jatropa and karanja Biodiesel shows that Biodiesel is more efficient than diesel. The thermal efficiency of Jatropa and karanja increases with increases in load rapidly but increases slightly for diesel. The volumetric efficiency of karanja, Jatropa and diesel increases when load increases

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- In the present investigation experimental work has been carried out to estimate the performance, combustion and emission characteristics of a single cylinder, four stroke variable compression ratio fuel engine fuelled with jatropha blended with standard diesel.
- The Brake power of Jatropha and karanja increases with increase in load but when load increase, Brake power of diesel decreases. B. S. F. C. of karanja and Jatropha drastically decrease but for diesel decreases gradually.
- From the Research it is Concluded that, Above 10% up to 20% Blend of Karanja & Jatropha gives the good Result with Decrease in Emission .

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