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Performances and emissions characteristics of diesel engine by using Jatropha oil

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ABSTRACT

They are various fuels being investigate as a potential substitute to the present extremely pollutants in diesel which is resulting from the withdrawing marketable sources. The vegetables oil is among the alternative fuel which can be directly use in C.I engine which having more cetane number and C.V. Though, the BTE of the vegetables oil is lesser to the diesel fuel. The custom of vegetables oil can causes to the more smokes, CO and HC emission. It be due to more viscosity and less volatility of the vegetables oil. The issue of more viscosity of vegetables oil is approach in various habits namely oil preheating, blending with other fuels, thermal cracking and transesterification. The main scope of project is to conduct an investigational analysis on the less heat rejection engine with help of raw Jatropha oil in the proportion 70:30 and diesel. The experiments conceded for the cylinder pressures when using the raw Jatropha oil and diesel. The results are obtained and specify the improved performances and emissions characteristics of engine with the Jatropha oil.

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1. Introduction

There are various energy fuels like CNG, hydrogen, Biogas, alcohols, Producer gas and vegetable oils were studied as the potential substitute for present high pollutants diesel fuels copied from the diminishing industrial source [1]. By the fossil fuel deplete, the bio fuels as a renewable source of energy afford huge potential. In our house production of fuel is purely not able to keep rapidity with the yet growing needs, forceful us depend more on imports [2]. With about 70% of local demand for the fuel by import and there is a big outflow of precious foreign exchange. In addition, the rising of fossil fuel usage has resulting to serious harmful problems like Green House Effect and global warming etc. [3,4]. Therefore future that a safe alternative is explores and exploited. Basically the bio fuel present a mainly feasible option as it can be getting from the renewable sources [5]. The Bio fuel origin possibly dibbles alcohols, biomass, biogas, vegetable oil and non edible etc. In some of this fuel might be used straight while other needs to formulate carry the relevant property close to the conventional fuel [6,7].

1.1. Vegetable oils

The vegetable oil as fuel which was develop the first C.I engine to run the vegetables oil. The Vegetables oil be able to use in the diesel engine as they has a higher cetane number and C.V is very close up to the C.I engine [8–11]. The Research work has exposed there be different issue linked with the vegetable oil be use as the fuel in the diesel engine, primarily it cause by the viscosity. The more viscosity is owing to big molecular mass and the chemical structures of the vegetable oil which leads to problem in combustion, pumping and an atomization in injector system to the C.I engine [12,13]. Because of more viscosity, in the long term operations, vegetable oil usually initiate the developments of gumming, formation of the injector deposit, ring sticking and inappropriateness with the conventional lubricating oil [14,15]. The vegetable oil can be harvest from various oil feed stock plants like sunflower seeds, soybeans, palm oils, rape seeds and some types of algae. The mainly important reflection in using vegetable oil is its melting point [16,17]. The vegetable oil molecule is collected three long carbon chain on a glycerol backbone and its properties are strong-minded by the individual fatty acid chains [18,19]. The chain length of the fatty acid is an inversely proportional to the thermal efficiency. The proportions and locations of double bond

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affect cetane number. The volume basis the heat content of the vegetables oil approximately similar to the diesel oil due to higher density [20]. The heating value minimizes with raising unsaturation as the result of the fewer hydrogen atoms and reduces by raising the saponification number. These are environmental user friendly, good lubrication and no knocking [21,22]. The disadvantages are causes the engine coking if misused, the engine by vegetables oil as the fuel is harder to start during morning and the use of vegetable oils will wipe out the injector pumps [23].

1.2. Biodiesel

The Bio-diesel is the form of diesel which is brought from the plant or animals and consists of the long chain fatty acid esters. Basically it equipped by the chemically reacting lipids namely animal fat, vegetable oil, soybean oil, propyl ester etc. They are certain demerits of biodiesel are lightly higher viscosity and lower volatility.

1.3. Jatropha oil and transesterification

Botanical name: Jatropha curcas
Family: Euphorbiaceae
Tamil name: Kattamanakku
English name: Physic nut, purging nut
Hindi name: Ratanjyot jangli
Erandi seed collection period: October to December

2. Materials and methods

The engine performance and emission test was conducted in compression Ignition engine. The Jatropha seed was obtain from the Biodiesel department. The low extraction ratio of oil is mostly due to the lower efficiency of the engine which is used and the long time storage after harvest. The first sample of blend is equipped by mixing of 200 ml Jatropha oil with 1900 ml of diesel. The another sample is equipped by mixing of 350 ml of Jatropha oil with 1600 ml diesel. Finally, the 3rd sample is done by mixing of 500 ml of Jatropha oil with 1600 ml of diesel.

2.1. Blends properties

The sample blend properties are inspecting at Laboratory. The viscometer is use to find viscosity of diesel blend. The blend cloud point is inspected by cloud point test tube method. The flash point of the blend is noted by closed cup apparatus test.

2.2. Equipment

The experimental setup is consists of an I.C engine with four cylinder, water cooled and constant speed engines. The specification for the engine is shown in below.

2.3. Specifications of test engine

Made: Kirloskar AV-I
No of cylinder: One
Cooling Type: Water
Ignition: Compression Ignition
Diameter: 80 mm
Stroke Length: 110 mm
Compression ratio: 16.5:1
Speed: 16.6:1
Brake Power: 3.70 kW
BHP: 5
Fuel oil: H.S. Diesel
SFC: 24.5 g/kWh
Lubricating oil: SAE 30/SAE 40 (Room temperature above 45 °C)

Generally the engine was connected with hydraulic dynamometer. The dynamometer is helped to load the engine at different speeds. The dynamometer cycle containing of water pump, pipes, water tank, brake turbine and valves.

2.4. Specifications of MRU exhaust gas analyser

Oxygen: 0.02%
Carbon dioxide: 0. 2%
Carbon monoxide: 0. 2%
Carbon hydride: 1 ppm
Rounds per minute: 400–1000 °C/min
Temperature: 40–640 °C
Response time: 15 sec
Weight: 14.5 kg
Dimensions: 550 × 320 × 210 mm

2.5. Specification of Kane MAY NOx analyzer

Gas: Nitric oxides
Range: 0 to 5000 ppm
Accuracy: ± 6% of reading > 100 ppm
±5ppm < 100 ppm
Sensor type: Electro chemical
Dimensions: 230 mm × 120 mm × 55 mm
Weight: 590 g (including batteries)

2.6. Exhaust probe

Insertion length: 175 mm
Fixed length: 100 mm
Flexible length: 75 mm
Maximum temperature probe: 600 °C
Total hose length: 5 m nominal
Maximum temperature hose: 50 °C
Maximum temperature probe: 600 °C
Total Hose length: 2 m nominal
Maximum temperature hose: 50 °C
Water trap: 10 cc approximately
Maximum temp.: 50 °C

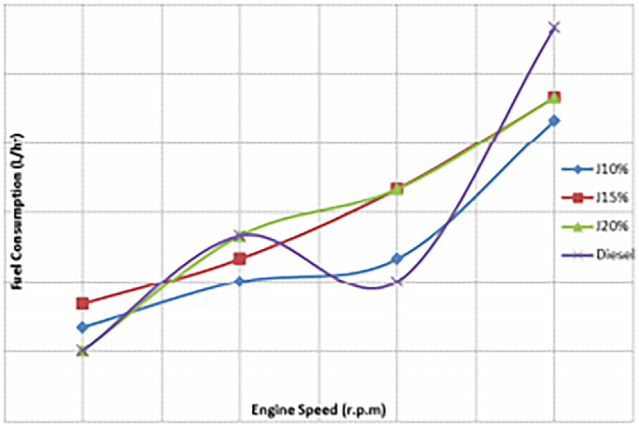

Fig. 1. Specific Fuel Consumption.

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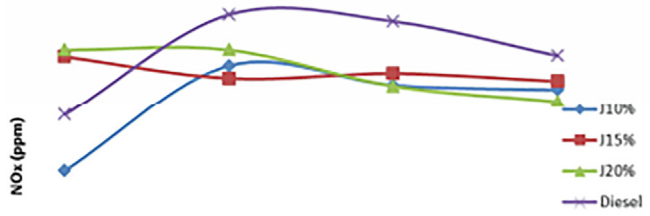

Fig. 2. NOx Emission.

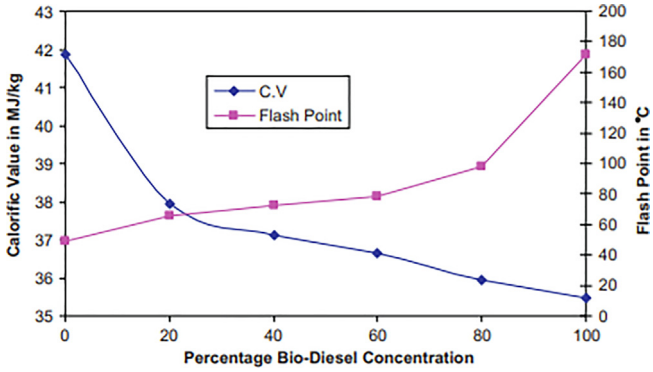

Fig. 3. Bio diesel concentration vs Calorific value, Flash point.

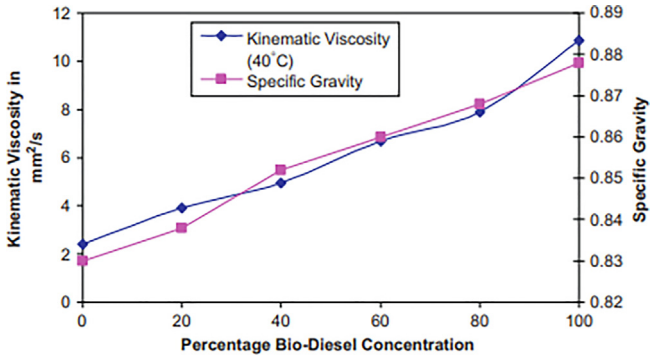

Fig. 4. Bio diesel concentration vs Kinematic viscosity, Specific Gravity.

3. Results and discussion

The various results of engine performance, emission and blend fuel properties were obtained and discuss in the following section (Figs. 1–4).

4. Conclusion

The ultimate present work is on the way to study the usage of Jatropha diesel blends as a substitute to the diesel in compression Ignition engines. It is noted the blend of Jatropha and the diesel can be fruitfully use with satisfactory performances and good emission than the ordinary diesel up to definite extents. In experimental study is accomplished that blend of Jatropha with the diesel up to 41% by the volume can replaces the diesel for C.I engine for receiving lower emission and good performances and help to achieve the energy economy, rural economic development and environmental protection. In future conventional fuel may be fully replace by bio-diesel and may provides the possible solutions for much aggressive environmental pollution problem. The fuel property of Jatropha diesel blends was tested like viscosity, calorific value, density and flash point is determined. It was noted that the raise in the viscosity, density and flash point of fuel blend with an augment in content of Jatropha oil. Same way, the C.V of the fuel blends somewhat decreased with augment of the Jatropha oil in blends.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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