Evaluation of Performance Characteristics of Pre-Heated Milk Scum Oil Bio Diesel on a Diesel Engine at Different Fuel Injection pressure

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Abstract

Biodiesels are the main renewable and carbon neutral sources for compression ignition engines. The main reasons of technical problems arising from the use of various biodiesel are the high Surface Tension and the high viscosity. In the CI engine, high surface tension and viscosity causes improper homogeneity in charge and fuel atomization. Thus preheating is the method to decrease viscosity of the biodiesel. The preheating of biodiesel at different temperature like 45°C, 50°C by using the exhaust gases decreses the viscosity and surface tension which improves better fuel injection and there by improves performance of the engine. Preheating of biodiesel can be made by using special arrangement of exhaust manifold. Experiment is conducted at different fuel injection pressure 180bar, 200 bar.

Keywords: Biodiesel preheating, Injection pressure.

1. INTRODUCTION

The world's industrialization and motorization are escalating, which has resulted in a sharp rise in the demand for petroleum fuels.. The world reserves of primary energy and raw materials are obviously limited. Finding alternative fuels that can be created from locally available resources, such as alcohol, biodiesel, vegetable oils, etc., is therefore important. Because biodiesel's injection, ignition, and exhaust characteristics differ from those of diesel, its use is restricted. Vegetable oil has a high density and viscosity, which interferes with the injection process and causes poor fuel atomization. Numerous techniques have been employed to resolve these issues brought on by the high viscosity of biodiesel. These include biodiesel blends, preheating the biodiesel one of the primary factors influencing an engine's performance is the fuel injection pressure. Fuel injection pressure has a direct impact on the atomization of injected fuel, enabling a cleaner burn and reducing pollutants.

In India, 210 million tonnes of milk are produced each year. Across the nation, a vast number of dairies are managing this milk. The current study shows that biodiesel made from dairy waste scum oil can replace petro-diesel in some situations. The performance Characteristics evaluated are Break power (BP), Indicated power (IP), Mechanical efficiency (ME), break thermal efficiency (BTE), brake specific energy consumption (BSEC). Comparisons are made between the findings of experimental research using biodiesel blends and diesel.

2. METHODOLOGY

2.1 Extraction of scum oil from milk scum

The scum collected was first refined by hand picking of coarse and floating impurities. It was then heated till it reaches 100^0C remove all it moisture contents and was strained which in turn filtered it. After the filtration processes purified scum was obtained. Purified scum oil was used for experimentation. Before making a batch of biodiesel, the first step is to determine the best catalyst by titrating and calculating the amount of water present in the feedstock. Before making a batch of biodiesel, the first step is to determine the best catalyst by titrating and calculating the amount of water present in the feedstock.

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2.2 Fuel characteristics of the tested fuel

A hydrometer, a bomb calorimeter, and a kinematic viscometer are used to determine the primary fuel characteristics of diesel and milk scum biodiesel, such as specific gravity, calorific value, viscosity, flash point, and fire point.

2.3 Pre-heating of blended milk scum oil

Bio-diesel is preheated to different temperature by using different methods. Before putting biodiesel into a combustion cylinder, the preheating procedure includes heating the fuel. The preheating temperature range for biodiesel is 30°C, 35°C, and 45°C. In this method we use Exhaust gas to heat the Bio-diesel. Before sending the Bio-diesel into the engine it is preheated in a separate chamber by using the Exhaust gas

3. Fabrication of A Pre-Heating Chamber

The container of the preheating chamber is fabricated with steel sheet and inside the chamber copper tube is placed through which fuel is passed. When contacted to exhaust fuel line exhaust gas flows through the preheating chamber over the copper tubes hence fuel flowing through copper tubes gets heated.

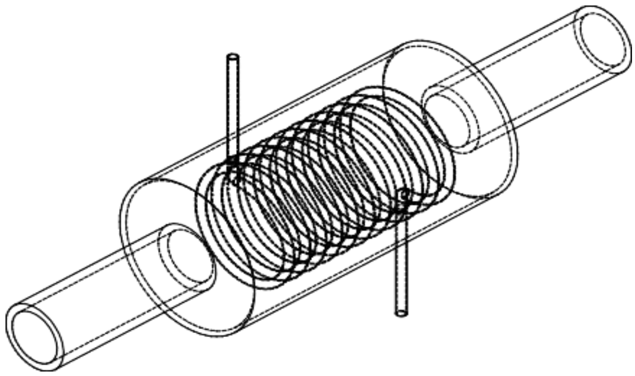


Figure.1.2D view of a pre- heating chamber

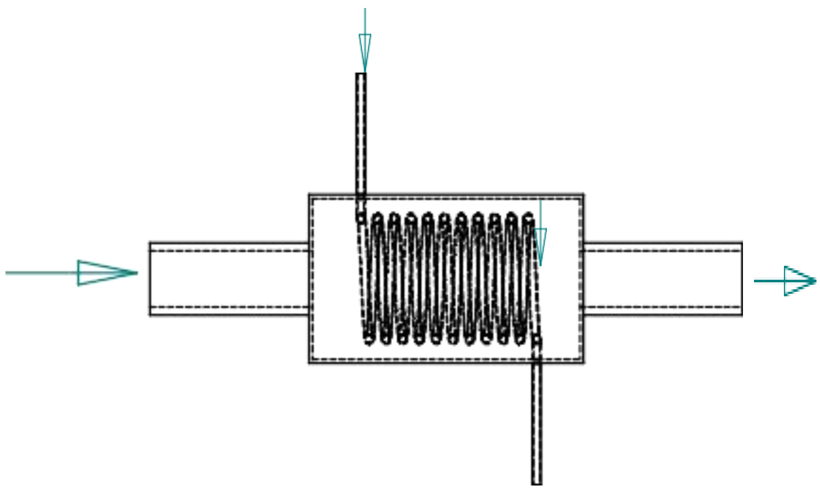


Figure.3. Fabricated pre-heating chamber

Figure.4. Assembly view

4. EXPERIMENTAL PROCEDURE

- Step 1: Turn on the control panel's power and set the servo stabilizer's supply voltage to 220 volts.
- Step 2: The pump is turned on, the main gate valve is opened, and the water flow rates for the engine cylinder jacket (300 litres per hour), calorimeter (50 litres per hour), dynamometer, and sensors are set.
- Step 3: Fuel is allowed inside the container where it is heated for different temperature Using exhaust gas, after attaining the required temperature it is passed to the engine.
- Step 4: To reach steady state, the engine is started and allowed to run for 20 minutes.The engine VCR software is used. To reach steady state, the engine is started and allowed to run for 20 minutes. Between two load testing, the engine is first operated with diesel under loading circumstances such as 0, 2.5, 5, or 7.5kg. Before taking the readings, the engine is driven for five minutes to allow it to stabilise. Speed, exhaust gas temperature, brake power, and peak pressure are performance indicators that are measured at each loading situation under steady state settings. The experiments are repeated for various preheated of biodiesel like 45°C, 50°C and at various fuel injection pressure like 180 and 200 bar. The characteristics such as total fuel consumption, brake-specific fuel consumption, brake-specific energy consumption, and brake thermal efficiency are computed using the experimental findings. Then, for both diesel and biodiesel, break-specific fuel consumption and brake thermal efficiency are displayed with respect to loading circumstances.

Figure.5. Engine setup

5. RESULTS

5.1 Performance Characteristics

5.1.1 Fuel: Milkscum oil (B-10) Pressure=180bar, Temperature=45^{0}C, C.R=17.5

Table 1.Performance Characteristics for Milkscum oil (B-10), 45^{0}C

SI.NO	LOAD (Kg)	B.P (kW)	I.P (kW)	BSFC (Kg/Kw-hr)	BTE(%)	ME(%)	ITE(%)
1	0	0.065	2.507	6.033	1.296	2.609	49.670
2	2.5	0.619	2.738	0.779	10.297	22.591	45.580
3	5	1.232	3.740	0.477	15.792	29.507	47.937
4	7.5	1.757	4.151	0.424	18.428	42.328	43.537

5.1.2 Fuel: Milkscum oil (B-10) Pressure=180bar, Temperature=50^{0}C, C.R=17.5

Table 2.Performance Characteristics for Milkscum oil (B-10), 50^{0}C

SI.NO	LOAD (Kg)	B.P (kW)	I.P (kW)	BSFC (Kg/Kw-hr)	BTE(%)	ME(%)	ITE(%)
1	0	0.069	2.248	5.895	1.326	3.082	43.034
2	2.5	0.609	3.068	0.764	10.231	19.833	51.588
3	5	1.201	4.069	0.450	16.396	32.944	55.566
4	7.5	1.823	3.985	0.343	22.764	45.750	49.757

5.1.3 Fuel: Milkscum oil (B-10) Pressure=200bar, Temperature=45^{0}C, C.R=17.5

Table 3.Performance Characteristics for Milkscum oil (B-10), 45^{0}C

SI.NO	LOAD (Kg)	B.P (kW)	I.P (kW)	BSFC (Kg/Kw-hr)	BTE(%)	ME(%)	ITE(%)
1	0	0.179	2.937	2.437	3.216	6.090	52.085
2	2.5	0.596	2.783	0.820	9.532	21.435	44.471
3	5	1.678	3.847	0.354	22.068	36.749	58.266
4	7.5	1.637	3.82	0.448	17.44	42.805	40.753

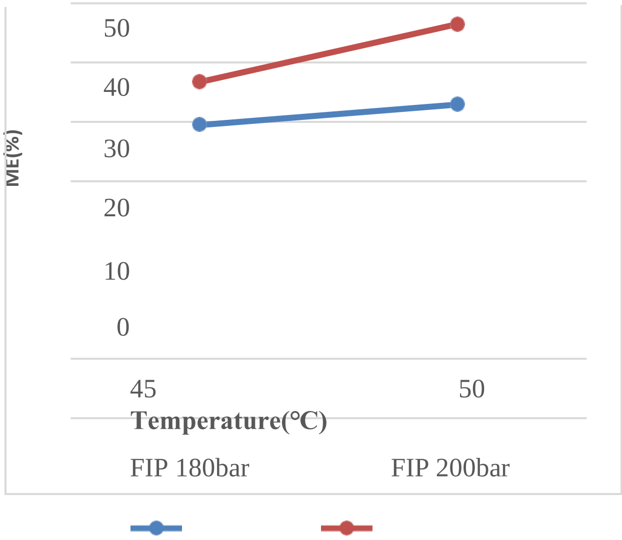
5.1.4 Fuel: Milkscum oil (B-20) Pressure=200bar, Temperature=50^{0}C, C.R=17.5

Table 4.Performance Characteristics for Milkscum oil (B-10), 50^{0}C

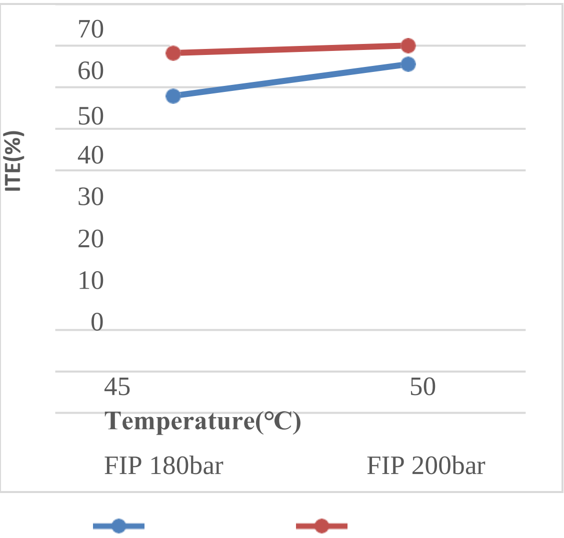
SI.NO	LOAD (Kg)	B.P (kW)	I.P (kW)	BSFC (Kg/Kw-hr)	BTE(%)	ME(%)	ITE(%)
1	0	0.653	3.610	0.580	13.479	18.086	74.528
2	2.5	0.758	3.563	0.596	13.128	21.286	61.674
3	5	1.789	4.567	0.289	27.092	46.498	60.051
4	7.5	1.510	4.004	0.438	17.842	37.711	47.313

6. GRAPHICAL REPRESENTATION

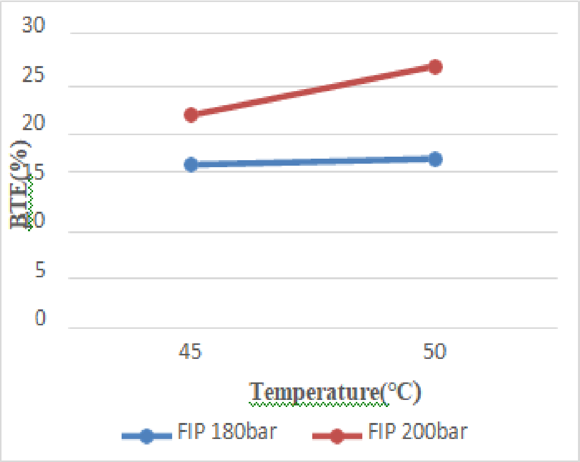
6.1 Fuel: Milkscum oil (B-10) Load=5kg



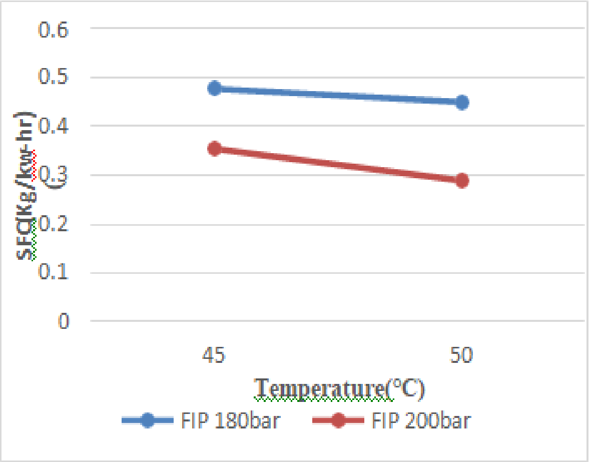
Graph 1.Mechanical efficiency (%) vs Temperature (^{0}C)



Graph 2.ITE (%) vs Temperature (^{0}C)



Graph 3.BTE (%) vs Temperature (^{0}C)



Graph 4.BSFC (Kg/KW-hr) vs Temperature (^{0}C)

7. CONCLUSION

- Pre-heating biodiesel efficiently lowers its kinematic viscosity and density, which optimises biodiesel injection by helping the fuel atomize more evenly at the higher temperature of the biodiesel. Preheating decreases the ignition problem by reducing the ignition delay time during cold start of engine in cold countries.

- For B10 blend 5Kg load as the temperature increases the mechanical efficiency will increases by 3.4% for 180bar Fuel Injection Pressure and 9.749% for 200bar Fuel Injection Pressure.

- For B10 blend 5Kg load as the temperature increases the Indicated thermal Efficiency will increases by 7.629% for 180 bar Fuel Injection Pressure and 1.787% for 200 bar Fuel Injection Pressure.

- For B10 blend 5Kg load as the temperature increases the Break Thermal efficiency will increases by 0.604% for 180 bar Fuel Injection Pressure and 5.024% for 200 bar Fuel Injection Pressure..

- For B20 blend 5Kg load as the temperature increases the specific fuel consumption will decrease by 0.027 Kg/KW-hr for 180 bar Fuel Injection Pressure and 0.065 Kg/KW-hr for 200 bar Fuel Injection Pressure.

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