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Effect of Biodiesel Heating on Diesel Engine Performance

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ABSTRACT: This paper deals with the review of work done in use of biodiesel blends of vegetable oil in normal and preheated conditions as an alternative fuel for compression ignition engines. A four-stroke compression ignition engine has been used to study experimentally the performance by using biodiesel in normal and preheated conditions. Preheating improves the speed of operation of engine.

KEYWORDS: Biodiesel, Sunflower oil, diesel engine, engine performance, preheating.

I. INTRODUCTION

Energy generation is the backbone of growth and development of a country. Main sources have been fossil fuels, which are depleting. Depletion of fossil fuels and environmental pollution has demanded the use of alternative fuels.

Solar energy, wind energy, tidal energy, hydel energy, energy from biogas, energy from biomass, fuel cell, geothermal energy etc. are different resources for production of energy via renewable energy resources [1]. Biodiesel production from biomass is now considered to be the most recent, challenging and interesting field for researchers [2]. This approach is not new, even Rudolph Diesel experimented with powdered coal to peanut oil in 1900. And declared in 1911 in World fair in Paris in 1911 that "diesel engine can be fed with vegetable oils" [3].

These days researchers are working on biodiesel to replace or reduce the consumption of diesel oil. Biodiesel fuel is obtained from edible, non-Edible, straight vegetable oils, waste vegetable oil and algae [4]. The term bio-fuel refers to solid, liquid and gaseous fuel predominantly produced from bio mass. Transesterification method is used for biodiesel production [5,6,7].

Biodiesels have higher viscosity than diesel oil and preheating is used to reduce the viscosity [8]. This approach is to improve combustion without modifying the engine design.

II. LITERATURE REVIEW

Maharana et al [1] evaluated the performance of engine by use of biodiesel, of palm oil and palm oil blends. Performance included the comparison of Load and Brake thermal efficiency, Load and brake power and load and BSFC (brake specific fuel Consumption). Blends used were from B10 to B30 proportions and found that Brake Power does not get much effected in these proportions, Brake specific fuel consumption is Higher due to lower calorific value of biodiesels and brake thermal efficiency is higher.



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Singh et al [9] compared the property of biodiesel (jatropha oil) and diesel oil. The performance analysis included brake power to load and load to efficiency. Mechanical efficiency was found to increase with blending percentage.

Rao et al [10] compared the characteristic of diesel and jatropha oil and also evaluated the emission effect. The main comparisons were Brake power to SFC (Specific fuel consumption), Brake power to thermal efficiency and brake power to pollutants.

Tushar et al [11] analyzed the effect of biodiesel preheating on CI engines. Preheating technique decreases the viscosity of the biodiesel. The preheating of biodiesel at different temperature between 60° C to 150° C. Pre-heating reduces the viscosity surface tension which improves the fuel injection.

Ramkumar et al [12] compared the performance of preheated vegetable oil with unheated vegetable oil. In all the cases BTE (Brake thermal efficiency) of preheated vegetable oil is higher than unheated vegetable oil. BSEC (Brake specific energy consumption) of preheated vegetable oil is almost equal to diesel and lesser than unheated vegetable oil. It was found that HC and CO emission for preheated vegetable oil is lesser than unheated vegetable oil, were NOx is found to be higher for preheated vegetable oil. CO2 emission while using preheated vegetable oil is higher than unheated vegetable oil and diesel. The usage of vegetable oil neutralizes CO2 emission, so there will not be any new CO2 emission into the atmosphere. Preheated vegetable oil is a promising alternate for mineral diesel.

III. PROPOSED METHDOLOGY

In the present work, performance of the use of biodiesel has been verified experimentally on a 4-stroke compression ignition engine. Normal and preheated biodiesel has been used. The experiments have used blends of B20, B40, B60, B80 and B100 of sunflower oil and compared the results with those of pure diesel. B60, B80 and B100 blends were preheated to 90 to 100-degree C before combustion and results were compared.

Apparatus for Experiment

1. Engine Type- Single cylinder 4S diesel Engine Displacement –441.5cc Power –6.8kw @ 3600rpm Torque – 21.5 NM @ 2400 RPM Bore – 86 mm Stroke – 76 mm Figure-1 Four stroke CI engine

2. Tachometer Type- MaxTech DT-2234C non-contact type tachometer

3. Rope Brake Dynamometer





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IV. PROPERTIES OF SUNFLOWER OIL

Table-1 compares the properties of diesel oil and sunflower oil.

Table-1	Properties	of	diesel	oil	and	sun	flower	oi	Ĺ
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Property of fuel	Pure Diesel	Sunflower Oil
Flash point	98	274
Pour Point	15	-15
Cloud Point	18	7.2
CV	46.8 MJ/KG	*
Cetane Value	59	Less than 47
Density	0.823	0.87
Viscosity	4.0	33.9 cst@38

* No data available

V. DISCUSSION OF RESULTS

1. RPM of Engine

Tables 2 and 3 give rpm of engine under similar conditions before heating and after heating of biodiesel.

Fuel	RPM
Pure Diesel	1185
B20	985
B40	780
B60	680
B80	580
B100	479

Table-2 RPM before heating

Table-3: RPM after heating

Fuel Blends	RPM
B60	919
B80	730
B100	628

The rpm of engine with pure diesel is 1267 and with increasing blend, it continuously decreases and with pure biodiesel or B100 it is 560. But after heating process RPM of engine increasers. For B60, B80 and B100 RPM before heating 740, 580 and 479 and after heating it increased 920, 730 and 628 respectively which is 25% to 35% higher than normal fuel.



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2. Torque

Table-4 gives the torque of engine for diesel and different blends of biodiesel and preheated B60 and B80.

Table-4 Torque of engine with and without preneating of blodieser			
Fuel	Torque	Torque After Pre-heating	
Diesel	30.8@1250	-	
B20	32@980	-	
B40	32.64@849	-	
B60	34@720	32.4@870	
B80	34.4@629	32.96@750	

Table-4 Torque of engine with and without preheating of biodiesel

For pure diesel condition torque observation is 30.8@1250 and 21.5@2400 (given by engine manufacturer). For B20 it is 32@980, For B40 it is 32.64@849, for B60 it is 34@720 and for B80 it is 34.4@629. Graph 5(B) show after heating effect for blend B60 and B80 torques after heating are 32.4@ 870 and 32.96@ 750 which means rpm will increase for similar conditions.

3. Brake Power

Table-5 gives the brake power of engine for diesel and blends of biodiesel and preheated B60 and B80.

Fuel	Brake Power in kW	Brake Power kW (after heating)
Pure Diesel	4.031	*
B20	3.28	*
B40	2.901	*
B60	2.5	2.78
B80	2.26	2.5

Table-5 Brake power of engine with and without heating.

No data available

For pure diesel brake power is 4.031 kw, for B20 it is 3.28, for B40 it is 2.9, for B60 it is 2.5 and for B80 it is 2.26. Brake power decreases from B20 to B80. Brake power after preheating for B60 and B80 is 2.78 and 2.5. Which is 10% to 15% higher than normal B60 and B80.

VI. CONCLUSIONS

A 4-stroke compression ignition engine was used to study the variation of brake power and torque for different blends of biodiesel using sunflower oil. This study also includedpreheated B60 and B80 blends of biodiesel. Following conclusions are made;

- 1. Torque decreases with increasing percent of blends.
- 2. Brake power decreases with increasing percentage of blend.
- 3. Preheating improves the speed of operation.
- 4. Problem of higher viscosity and density can be reduced by preheating bio diesel before injecting it to combustion chamber. It will eventually reduce the ignition problem.

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