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Experimental Investigation on Performance of CI Engine using Biodiesel Prepared from Sunflower Oil and Waste Cooking Oil

Babita Singh
Asst. Prof, Mechanical Engineering Dept.
IGIT, Sarang,
Dhenkanal, India

Abstract- **Energy demands are increasing day by day and conventional fuels are depleting. Harmful gases are emitted from vehicles which pollutes the environment. So there is a need to develop alternate fuels. Many researchers have worked on alternative fuels and founr out good results.Edible oils such as sunflower oil , palm oil etc and non edible oil such as jatropha oil and waste cookin oil are very much used in CI engine. This paper presents the results obtained by doing experiments on a single cylinder 4 stroke CI engine. Performances like Brake Power, BSFC, BTE and Exhaust Gas Temperature by using four fuels diesel, B10, B15, B30. Results show that Brake Thermal Efficiency increases using B10. BSFC increases by using fuel blend compared to pure diese.**

Key Words: Brake Power, BSFC, Brake Thermal Efficiency, Exhaust Gas Temperature, Biodiesel, Waste cooking Oil, Sunflower Oil

1. INTRODUCTION

Increasing energy demands and need of a clean environment made many researchers to work on an alternative fuels that can be used in CI engines.One of the most promising alternative fuel is biodiesel prepared from many edible and nonedible oil. Many researchers had investigated the performances, emissions and combustion characteristics by using biodiesel produced from edible oil such as sunflower oil [3], palm oil and nonedible oil such as jatropha oil and waste cooking oil.[1,2]. Biodiesel prepared from neem oil and cotton seed oil are also used in Ci engine.[5].The use of biodiesel produced from different sources in CI engines lowers the exhaust emissions like CO_2,CO, unburnt hydrocarbons, compared to exhaust emissions from CI engine using diesel.

K. Velmurugan et.al.[8] used biodiesel prepared from mango seed as fuel in a diesel engine. Antioxidants diethyl amines, pyridoxine hydrochloride, tert butyl hydro Quinone were used to analyse the performance and emission characteristics. At higher loads BTE is lower for biodiesel and antioxidants mixture compared to diesel. At lower loads 20% biodiesel and antioxidant mixture produces higher BTE compared to diesel.

An experiment was conducted by J.Hemanadh et.al. [3] on a 4stroke, direct injection diesel engine by using hydrotreated sunflower oil as fuel. Brake specific fuel consumption decreases as compared to diesel. Brake thermal efficiency increses as compared to diesel. Edible and non-edible oil cannot directly be used in ci engines combustion chamber. The main problem is viscosity, as viscosity of most oil are high they may choke fuel line and proper atomisation is not obtained. So they are transestrified with the help of an alcohol, the byproducts produced sig glycerol.

S.Senthilkumar et.al. [9] used methyl ester produced from palm oil as fuel in a four stroke water cooled three cylinder diesel engine. Exhaust gas temperature are more for 40% biodiesel and 60% diesel fuel with additive compared to diesel at all speeds. Bsfc is higher for all speeds for fuel blends compared to pure diesel. Brake power produced is less for biodiesel diesel blend with additive than pure diesel.

M. Pugazhvadivua [6] The performance and exhaust emissions of a single cylinder diesel engine was evaluated using diesel, waste frying oil (without preheating) and waste frying oil preheated to two different inlet temperatures (75 and 135^0C). The engine performance was improved and the CO and smoke emissions were reduced using preheated waste frying oil. It was concluded from the results of the experimental investigation that the waste frying oil preheated to 135^0C could be used as a diesel fuel substitute for short-term engine operation.

2. MATERIALS AND METHODS OF BIODIESEL

The raw material for biodiesel preparation used is waste cooking oil, which was collected from different sources such as hostels and canteen. Pure sunflower oil was collected from nearest grocery shop. Unnecessary impurities in the oil such as solid matter and food residues were removed. The traces of water present in the oil are removed by heating process before trans-esterification process.

Fuel properties of biodiesel prepared from mixture of sunflower oil and waste cooking oil are given in table 1. Three fuel blend were prepared B10(10% biodiesel 90% diesel), B15(15% biodiesel 85% diesel) and B30 (30% biodiesel and 70% diesel) by volume and pure diesel.

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FUEL PROPERTIES.

Fuel type	Calorific value (MJ/kg)	Kinetic viscosity at 40°c (cst)	Flash point (c)	Specific gravity	Fire point(0c)
SOME	37	4.98	210	0.85	275
WFOME	39.18	4.81	190	0.88	261
Mixed	38.78	4.88	204	0.87	272
Diesel	45.343	2.44	58	0.842	68

Table 1. Fuel properties.

Kinematic viscosity of biodiesel is more than diesel. This property resist the proper fuel flow and proper atomization cannot be done in comparision to diesel.

3. EXPERIMENTAL SETUP AND TEST PROCEDURE

Experiment was conducted on a single cylinder 4stroke diesel engine with varying speed and varying loads

Fig 2 Engine set up

Engine Specifications

1. Engine model : single cylinder 4 stroke water cooled Diesel engine
2. Maximum Power Developed: 5HP
3. RPM:1500
4. SFC: 230 g/Kw-h
5. Lubricant Oil : SAE 30/ SAE 40

4. RESULT AND DISCUSSIONS.

4.1 Brake Power

Brake power is a measure of power produced by the engine.

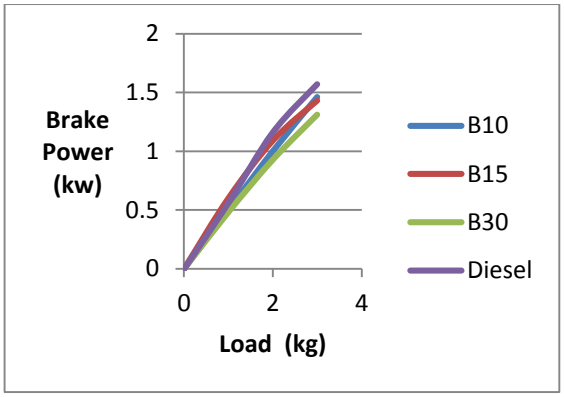

Fig 3 Brake Power vs Load

Fig 3 shows Brake Power vs Load graph. Brake power increases with load . All fuel blend shows slight decrease in Brake power as compared to diesel. This may be due to lower calorific value of blened fuel as compared diesel.

4.2 BSFC

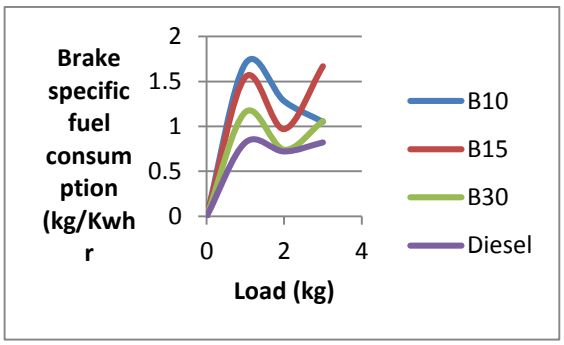

Fig 4 BSFC vs Load

Fig 4 shows BSFC vs Load graph

Brake specific fuel consumption is the measure of fuel consumed to produce required power in in some specific time. Brake Specific fuel consumption at first increases with load than decreases. All fuel blends have higher brake specific fuel consumption as compared to diesel. Similar results were obtained by K.Vijayaraj et. Al in their experiments using mango sedd oil.[4].

4.3 Brake Thermal Efficiency

Brake Thermal efficiency is the ratio of energy in brake power to the fuel energy. Fig 5 shows Brake thermal efficiency vs Load graph. Brake thermal efficiency increases with load. B10 shows higher brake thermal efficiency than diesel. This may be due to proper combustion of taking place in combustion chamber by use of B10 biodiesel. As the blending percentage increases brake thermal efficiency decreases.

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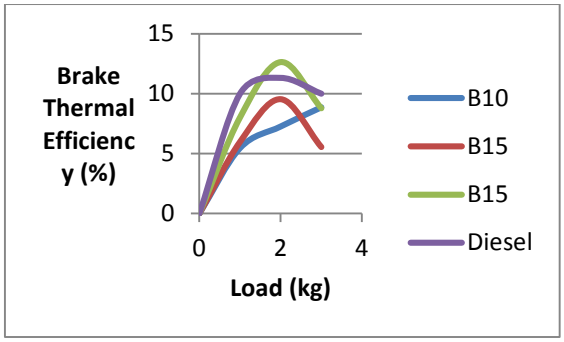

Fig 5 Brake thermal efficiency vs Load

4.4 Exhaust gas temperature

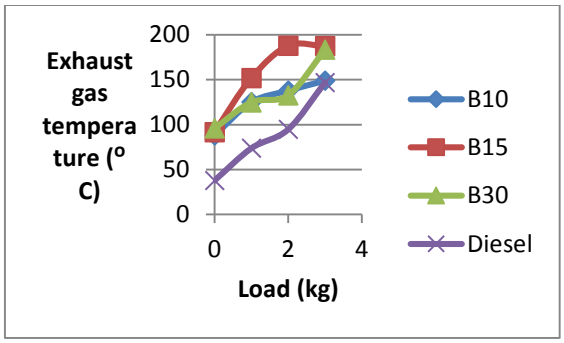

Fig 6 Exhaust gas temperature vs Load

Fig 6 shows Exhaust gas temperature vs Load graph Exhaust gas temperature increases as the load increases. It is highest for B15, it decreases as blending percentage increases to 30 % . All fuel blends gives higher exhaust temperature compared to diesel.

CONCLUSION

According to the results, the density, viscosity, and flash points of the blended fuel increase with the rise of biodiesel concentrations in fuel blend.

- Engine tests demonstrated that increasing biodiesel ratios up to 30% in the blended fuel reduced the engine brake power by about 5%.
- Increased the brake specific fuel consumption by 7-8% was obtained.
- There was an increase of the engine brake thermal efficiency of B10 compared to the diesel by 1.27%. But further increase in the blending ratio it decreases.
- Exhaust gas temperature increases as the load increases. It is highest for 15% biodiesel blended in diesel.

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