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Performance Characteristics of CI DI Engine Using Blends of Biodiesel (WCO) and Diesel Fuel

Rajesh Gurani [PR] S. N. Kurbet [CR]
Research Scholar,Department of Mechanical Engineering, Basaveshwar Engineering College, Bagalkot, Karnataka, India.
Professor and Head of Dept of Mechanical Engineering, Basaveshwar Enginnering College, Bagalkot Bagalkot, Karnataka, India.
Corresponding Author: Rajesh Gurani
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Abstract: The world is presently confronted with the twin crises of fossil fuel depletion and environmental degradation. As such, the situation demands for an alternate source of energy that can be used to overcome the forecasted future energy crisis. Biodiesel is proved to be the best replacement for diesel. This paper is mainly concentrated on the biofuel (produced from Waste Cooking oil) blends and their effects on performance characteristics like thermal efficiency (BTE), BSFC and exhaust gas temperature (EGT). The experiments were conducted for different blends of biofuel with that of the pure diesel. The results suggest that as the biofuels blend increases their will be increase in BTE, BSFC and EGT

I. INTRODUCTION

Fossil fuels consumption is increasing day by day because of increase in number of automobiles in recent years. With the increase in consumption and increasing prices of fossil fuel has made the researchers to find the alternate fuels which are renewable and environmental friendly. The depletion of crude oil would cause a major impact on the transportation sector**.** Of the various alternate fuels under consideration, biodiesel, derived from vegetable oils, is the most promising alternative fuel to diesel due to its sustainable development, energy conservation, efficiency and environmental preservation.

Combustion efficiency is a measurement of how well the fuel being burned is being utilized in the combustion process. The combustion efficiency or maximum heat content of the fuel is then based upon the quality of the mixture of fuel and air, and the amount of air supplied to the burner in excess of what is required to produce complete combustion.

This paper works on different biodiesel and their blends with pure diesel, used in variety of engines and its compatibility as a fuel for CI engine, are studied. In addition to this amount of pollutants produced are noticed along with performance parameters using fuel from variety of biodiesel produce from Waste Cooking Oil(WCO).

1. Objectives:

The main objectives of this are:

- Investigating the properties of the biodiesel as well as blends of biodiesel with diesel.
- Experimental investigation of the performance on single cylinder four stroke diesel engine using waste cooking oil methyl ester biodiesel and its blends.
- Evaluating the optimum performance parameters for maximum efficiency and minimum pollution.

2. Experimental set up:

The experiments are carried out on single cylinder, 4-stroke Kirloskar diesel engine. The schematic experimental setup is shown in fig. 1. Engine is interfaced with computer for measuring the different parameters. Engine software is used in computer to carry out the measurements. The engine is coupled with an eddy current dynamometer used to measure the emissions and smoke density.

Make	Kirloskar Engine
Bore & stroke	87.5mm x110mm
Type of cooling	Water cooled
Speed	1500 rpm
Compression ratio	17.5:1
Number of cylinder	1
Rated power	5.2 kW
Start of injection	23° bTDC
Injection pressure	205 bar

Table 1: Engine Specifications

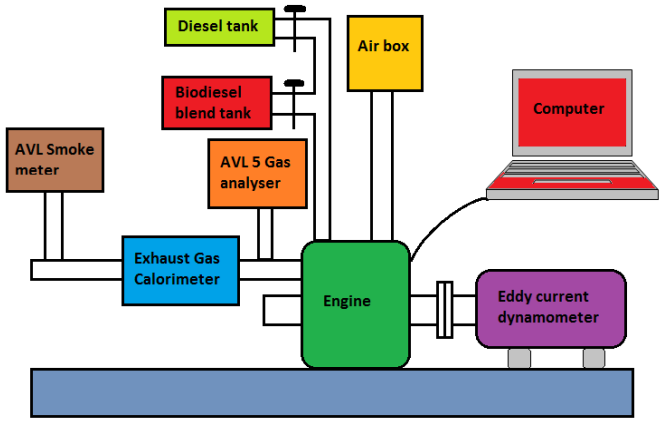

Fig 1: Schematic diagram of Experimental set up.

II. RESULTS AND DISCUSSION:

The performance of CI DI engine using the biodiesel namely WCO biodiesel with diesel blends and pure diesel are studied at different loads and at different injection pressure. The performance characteristics like thermal efficiency (BTE), BSFC and exhaust gas temperature (EGT) for biodiesel (WCO) and its blends with neat diesel are carried out at different loads and compared the results to get better characteristics.

a) Thermal efficiency of WCO biodiesel for different blends:

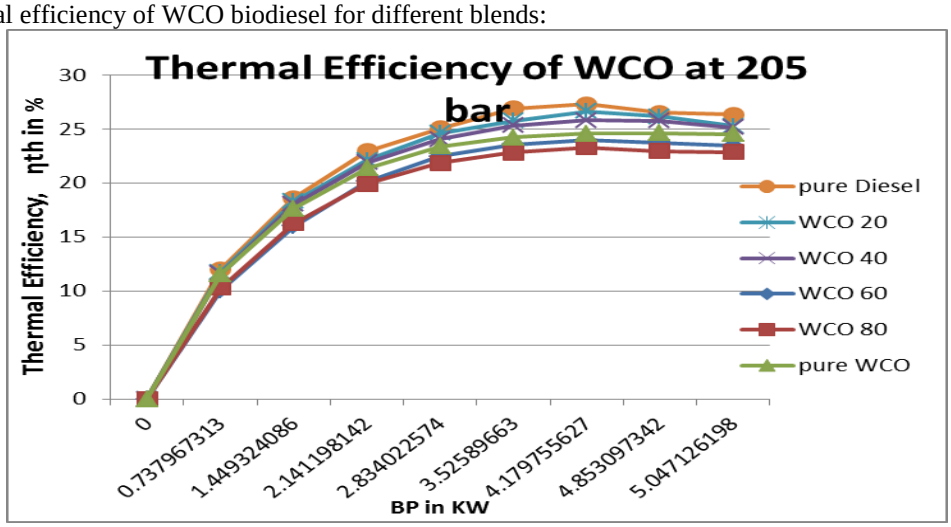

Figure 4.1. Variation of the brake thermal efficiency with brake power for diesel and WCO blends at 205bar.

The variations of brake thermal efficiency with change in brake power at 205 bar injection pressure are presented in figure 4.1. As the brake power increases the brake thermal efficiency increases, this is the characteristic of diesel engines. The brake thermal efficiency for the biodiesel (WCO) and diesel blends are comparable with pure diesel. Brake thermal efficiency of diesel is observed to highest compared with other blends. More brake thermal efficiency in case of diesel fuel may be due to higher heating value of diesel fuel. Brake thermal efficiency of W20 is very close to that of pure diesel, this may be due to the oxygen present in the biodiesel may take part in complete combustion of W20 blend this may produce the same thermal efficiency as that of pure diesel.

b) BSFC of WCO biodiesel for different blends:

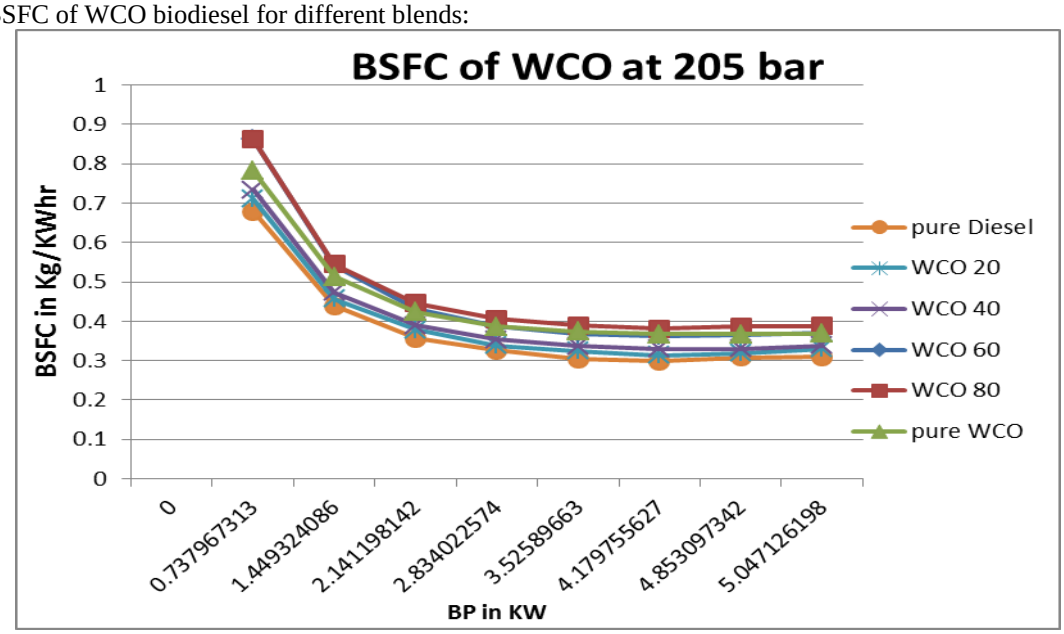

Figure4.2. Variation of the brake specific fuel consumption with brake power for diesel and WCO blends at 205bar.

The variation of brake specific fuel consumption with change in brake power at 205 bar injection pressure is presented in fig.4.2. It is observed from the figure that as power output of the engine increases the brake specific fuel consumption decreases. Brake specific fuel consumption of all the biodiesel (WCO) and diesel blends are higher compared to that of neat diesel fuel. This may be due lower heating value, higher density, viscosity and lower calorific value of the biodiesel fuels which leads to more quantity of biodiesel fuel supply is due its lower energy content of biodiesel fuel.

c) Exhaust gas temperature (EGT) of WCO biodiesel for different blends:

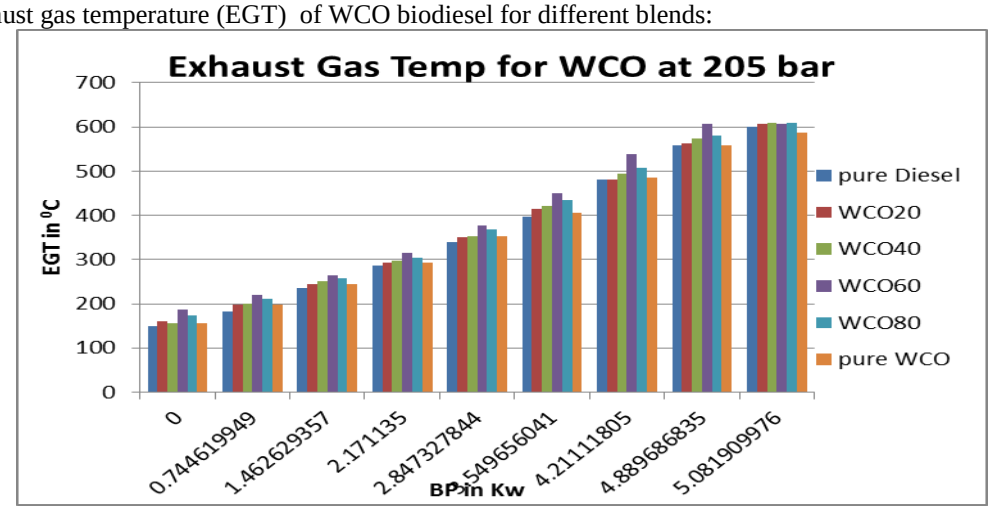

Figure4.3. Variation of exhaust gas temperature with brake power for diesel and WCO blends at 205bar.

The variation of exhaust gas temperature with respect brake power at 190 bar injection pressure is presented in fig.4.3. It is observed from the figure that as the brake power increases the exhaust temperature increases for all the biodiesel and diesel blends and also neat diesel fuel. This may be due more quantity of fuel is burned to get the higher output from the engine. The higher combustion temperature may be due better combustion of biodiesel (WCO) and diesel blends. The lower exhaust temperature means that more of the heat energy is converted to mechanical energy during that cycle. Due to the presence of oxygen in biodiesel may help in better combustion that may be the region for higher exhaust gas temperature in case of biodiesel (WCO) and diesel blends.

III. CONCLUSIONS:

From the present investigation it is concluded that

i) For WCO biodiesel Brake thermal efficiency of B20 is very close to that of pure diesel, because of presence of oxygen in the biodiesel leads to complete combustion. More brake thermal efficiency is observed for pure diesel in case of higher blends due to higher heating value of diesel fuel than the WCO biodiesel.
ii) The brake specific fuel consumption (BSFC) of all the biodiesel (WCO) and diesel blends are higher compared to that of neat diesel fuel, due its lower energy content of biodiesel fuel.
iii) The exhaust temperature increases for all the biodiesel and diesel blends and also neat diesel fuel. This may be due more quantity of fuel is burned to get the higher output from the engine. The higher combustion temperature may be due better combustion of biodiesel.

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