

Emission Characteristics of CI DI Engine Using Blends of Biodiesel (Waste Cooking Oil) and Diesel Fuel

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ABSTRACT: In the present era the whole world is concerned about the effect of environment pollution and the emissions from automobile because of use of fossil fuel is considered as a major contribution to it. The second aspect of the fossil fuel is the depletion of fuel leads to thinking of alternative fuel for running the automobiles. Biodiesel is proved to be the best replacement for diesel because of its unique properties like significant reduction in green house gas emissions, non-sulfur emissions, non-particulate matter pollutants, low toxicity and biodegradability. This paper is mainly concentrated on the biofuel (produced from Waste Cooking oil) blends and their effect on the emissions of automobiles. After conducting several experiments it is concluded that the emission level for HC and CO are less for biodiesel and its blends and for NOx and Smoke density is higher for biodiesel and its blends when compared with pure diesel.

KEYWORDS: WCO Biodiesel, HC, CO, NOx and Smoke emission levels

I. INTRODUCTION

Motor vehicles play a conspicuous role in the modern industrial economy—and in shaping our natural and built environment. Cars and light trucks offer rapid, reliable, and convenient mobility on demand to an ever-growing number of people in countries throughout the world. But for all their positives, automobiles carry with them many negatives. Vehicles are a major contributor to air pollution around the world.

Vehicles account for most of the carbon monoxide (CO), and a large share of the hydrocarbons (HC), nitrogen oxides (NOx), and particulates in major urban areas. Diesel engines have higher emissions of NOx and they have significant emissions of fine particulates. Recent evidence shows that fine particulates may be the most serious threat to human health in urban areas. Vehicle emissions are responsible for up to 50 percent of the emissions that form ground-level ozone and up to 90 percent of carbon monoxide in major metropolitan areas. They also contribute to global warming, accounting for a large and growing share of greenhouse gas emissions worldwide.

Biodiesel is superior to fossil diesel fuel in terms of exhaust emissions, cetane number, flash point and lubricity characteristics, without any significant difference in heat of combustion of these fuels. Moreover, biodiesel returns about 90% more energy than the energy that is utilized to produce it. Biodiesel mixed with conventional diesel in some proportions can be used to run any existing conventional compression ignition engine and does not require any modifications to be done to the engine. Due to benefits like renewable in nature, low cost and greenhouse gas reduction potential, biodiesel is nowadays incorporated all over the world. It is also estimated that India can supplement 41.14% of its total diesel fuel consumption, if resources like waste cooking oil and other bio wastes were used as raw material for biodiesel production.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 8, August 2017

II. 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.
- Smoke and various emissions are measured using smoke meter and gas analyzer.

III. 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 soft 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

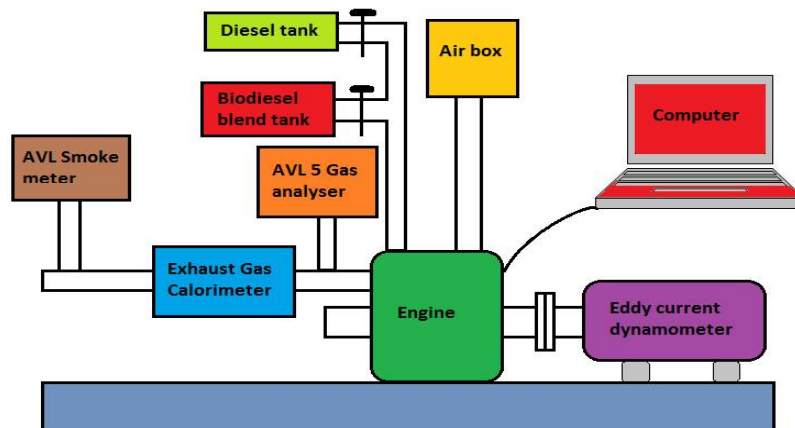


Fig 1: Schematic diagram of Experimental set up.

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Vol. 6, Issue 8, August 2017

IV. RESULTS AND DISCUSSION

The performance of CI DI engine using the biodiesel namely WCOME biodiesel with diesel blends and pure diesel are studied at different loads and at different injection pressure. The performance and emissions of different blends and for neat diesel are carried out at different loads and compared the results of various blends of biodiesel and diesel with neat diesel fuel.

a) Effect of Bio-diesel on smoke emission:

The smoke emission level for different BP for each blend is obtained from data and were plotted as shown in figure 2. The graph indicates that smoke level for WCO biodiesel and its blends has increased with less percentage compared with that of the pure diesel engine up to a load of 4.2KW or 15kg and beyond this 4.2KW load there is a sign of decrease in smoke emissions for WCO biodiesel and its blends. At the time of injection a smaller atoms of biodiesel fuel having lesser inertia takes longer time for combustion or incomplete combustion at lower loads (below 4.2KW). This results in increase smoke level for WCO biodiesel and its blends.

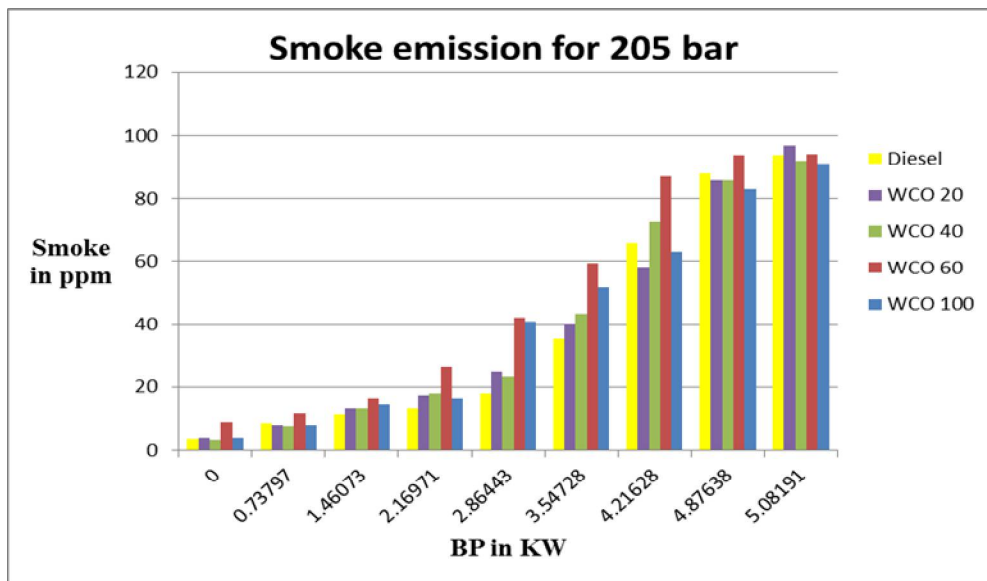


Fig 2: Emissions of Smoke Density for 205 bar

b) Effect of Bio-diesel on CO emission:

The CO level for different BP for each blend is obtained from data and was plotted as shown in figure 3. From graph it is observed that there will be two distinguishing elements, up to 4.2KW load all emissions are at lower level for biodiesel blends including diesel also and there will be an abrupt increase in emissions for all fuels. From graph it is evident that for lower loads (up to 4.2KW) the CO emissions for biodiesel and its blends are nearly equal to or slightly higher than that of neat diesel. This is because of increase in blend percentage leads to increase in viscosity of fuel and this forms the larger atomic size of pure particles during injection. This results in ignition delay time, hence the incomplete combustion. As a result there will be increase in CO emissions for biodiesel and its blends at lower loads.

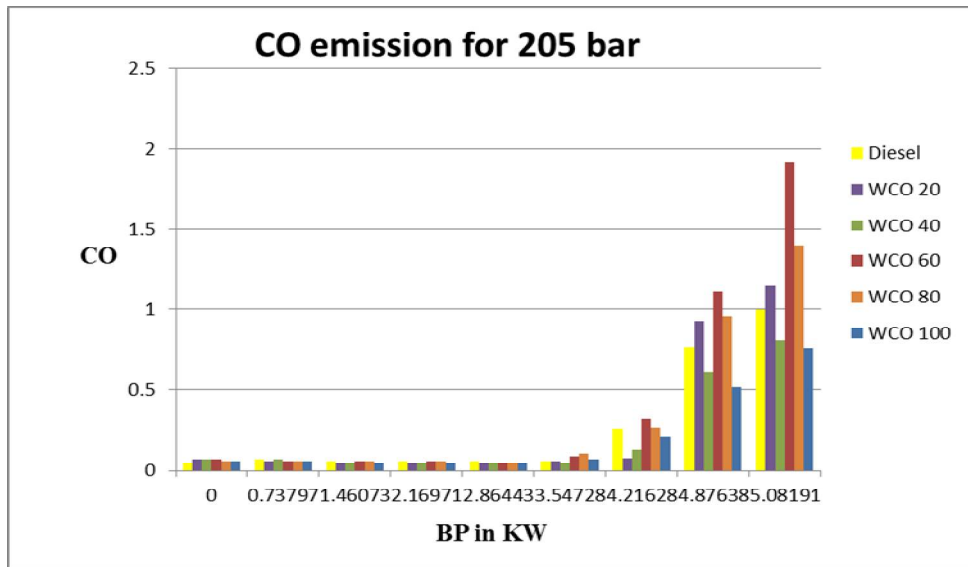


Fig 3: Emissions of CO for 205 bar

c) Effect of Bio-diesel on HC emission:

The smoke emission level for different BP for each blend is obtained from data and was plotted as shown in figure 4. From graph it is evident that at lower loads (up to 4.2KW) HC emissions for biodiesel and its blends are lower compared to that of neat diesel. At higher loads (beyond 4.2KW) there will be an adverse effect. At lower loads the lower emission level of HC for biodiesel and its blends is due to availability of excess amount of oxygen in biodiesel molecules. This leads to complete combustion of fuel and lower HC emissions. At higher loads because of improper evaporation and mixture proportions, there will an incomplete of combustion of fuel leads to increase in HC emission level for biodiesel and its blends.

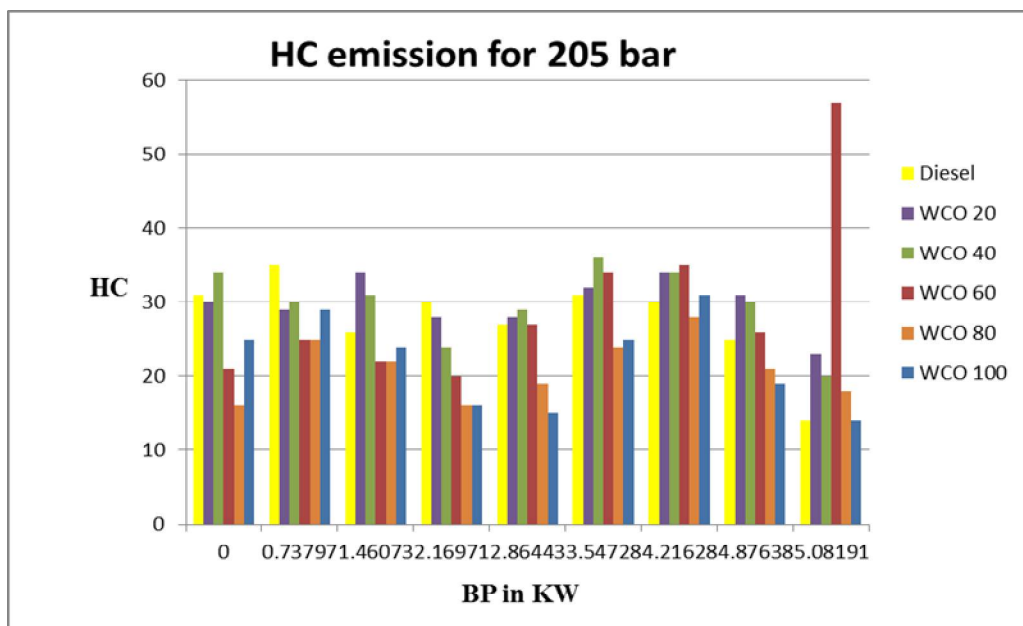


Fig 4: Emissions of HC for 205 bar

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Vol. 6, Issue 8, August 2017

d) Effect of Bio-diesel on NOx emission:

The smoke emission level for different BP for each blend is obtained from data and were plotted as shown in figure 5. By analysing the graph it is clear that at lower loads (less than 4.2KW) NOx emissions for biodiesel and its blends are higher when compared with the pure diesel. In molecular structure of biodiesel the presence of oxygen is used in combustion of fuel. At lower level due to incomplete combustion these oxygen molecules are not converted from CO to CO₂. This CO will react with Nitrogen and forms NOx at lower loads and hence there will be increase in NOx emissions at lower loads.

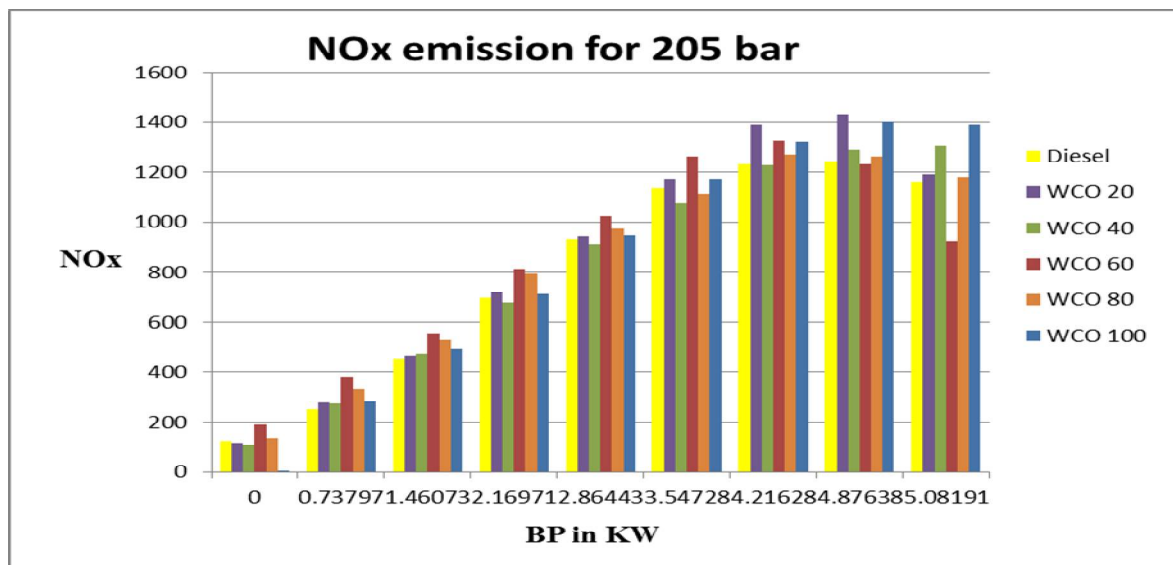


Fig 5: Emissions of NOx for 205 bar

V. CONCLUSIONS

From the present investigation it is concluded that the emission levels of HC, CO, NOx and smoke density have different limits at lower loads and at higher loads, the results are adverse with each other. From this investigation the emission level for HC and CO are less for biodiesel and its blends and for NOx and Smoke density is higher for biodiesel and its blends when compared with pure diesel. This investigation is also suggests that the controlling of emissions for HC, CO, NOx and smoke density is effective for lower blends of biodiesel with that of diesel.

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