

Performance and Emissions Characteristics of HCCI Engine with Eucalyptus Biodiesel

A.Renuka Prasad, Rakesh Bhandari, Donepudi Jagadish

Abstract: Biodiesel is the most favorable alternative fuel for the Fossil fuels. The fossil fuels are Gasoline, Natural Gas and Diesel etc. The Diesel are used for Transportation of vehicles, large scale and small scale industries. It develops more hydrocarbons, oxides of nitrogen, Particulate Matters and carbon dioxide. These emissions are harmful of our health. The Homogeneous Charge Compression Ignition (HCCI) technology is new combustion concept alternate to the CI engines, it produces low exhaust emissions and high efficiency. HCCI technology is the ideal technology for both SI and CI engines. The HCCI combustion depends upon the quality of homogeneous mixture (fuel and air). The present research paper represents the Experimental and Combustion of HCCI mode of engine with Eucalyptus biodiesel. The Eucalyptus biodiesel is blend with Diesel. The percentages are 90% of Diesel and 10% of Eucalyptus oil.

Keywords: Alternative fuels, Emissions, HCCI engine, Fossil fuels and Eucalyptus oil.

I. INTRODUCTION

The fossil fuels are Crude oil, Natural Gas and Coal are reducing and exhausted, because of day to day requirement is increasing for crude oils in the world [1]. The Biodiesels gives a solution to the worldwide fossil fuels crisis . The Automobiles are used Petrol and Diesel, these are developing energy for running the vehicles automatically, it develops more exhaust gases. Because of the exhaust gases the air is pollutant. Our researchers find the several alternative energy sources for increasing the population. The Biodiesel is produced from different types of vegetables [2]. The vegetable oils are best alternative for the Diesel source. In India large scale biodiesel production is difficult, because of competition of Food crops creating imbalances of economic. The feasible solution for reaching this difficulty is take the non-edible oils[4]. The Jatropha, Pongamia, polanga and Eucalyptus etc.

Table 1: Properties of Eucalyptus oil.

| Properties | Diesel | Eucalyptus oil |
|------------------------------|---------|----------------|
| Density (Kg/m ³) | 830 | 913 |
| Molecular weight | 200-240 | 310 |
| Boiling Point (°C) | 180-340 | 175 |
| Viscosity | 2.5 | 3.2 |

| | | |
|------------------|----|----|
| Flash Point (°C) | 58 | 93 |
| Cetane number | 48 | 52 |

are non edible oils. According to these oils, Eucalyptus oil is the most favorable, cheaper, high cetane number and also its large availability of India. And, it also available throughout the year. The main theme of this research paper is to Determine the Performance and Emissions characteristics of Eucalyptus non edible oil in the Homogeneous Charge Compression Ignition engines. Table 1 shows the properties of Eucalyptus oil. From the table, see the properties of Eucalyptus oil are feasible to be used in HCCI engine.

II. EUCALYPTUS OIL IN INDIA

Eucalyptus biodiesel is best alternative for the fossil fuel. It is extracted from eucalyptus seeds and production throughout the year in India [9]. The Eucalyptus tree planted by Tippu Sultan his garden Nandi hills in India at, Karnataka State in the year of 1790. The Nandi hills are located near Mysore. These tree seeds are imported from the country of Australia and huge number of species are started [3,5]. In 1843 and 1856 regular plantation are started in India for the meet of demands for firewood in Nilgiri, Tamilnadu. These are planted in different parts of the country and small villages also. In villages these leaves are used for Ayurvedic purpose. The different species are found in the year 1954-55 Eucalyptus citridora, Eucalyptus crebra, Eucalyptus camaldulensis, Eucalyptus tereticornis, Eucalyptus intermedia, Eupleres major, Eucalyptus polyanthemus and E.tereticornis [6]. From the 160 species different types of Eucalyptus found in India. The different huge number of species E.tereticornis specie is best specie in India. The E.tereticornis specie is also called Mysore gum or glue.

The Eucalyptus biodiesel produced through eucalyptus seeds with the different types of machines. In seeds oil content is 60% form of cineole content [8]. The main features of the eucalyptus tree are fast growing plant, stands with high wind, fire is hardy and also to adapt a different weather conditions. Mostly 1,000,000 ha of Eucalyptus plantation are over by the Forest State Department and Development Forest Corporation expected 600 million seeding planted in different types of lands [7,10]. These trees are planted near hill areas, denuded and barren plains. The most wonderful one is the tree is growing about 12m with in 3 years.

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III. EXPERIMENTAL SETUP

The engine is modified to work Homogeneous Charge Compression ignition (HCCI) mode. The engine is Kirloskar made single cylinder, water cooled engine, developed the 3.5kW at 1500rpm. The specification of the engine bore of 87.50mm., a stroke of 110mm, swept volume of 661.45cc and Compression ratio of 17.50. The schematic diagram shown in Fig.1. The emissions are hydrocarbons, carbon dioxide, oxides of nitrogen and particulate matters are measured through the Exhaust gas analyzer.

First we determined the performance and emissions on pure Diesel with HCCI mode of engine, taking the readings of time taken for 10cc of fuel consumption by using stop watch and Manometer difference with the U-tube manometer with varying the engine loads. Then, we determined the blend of Eucalyptus biodiesel (B₁₀) testing with HCCI mode of engine followed by the same procedure determined the performance and emission parameters. Then we calculated the performance parameters such as Brake Thermal efficiency and Brake Specific Fuel Consumption etc. of the testing engine.

IV. RESULTS AND DISCUSSION

The Experiments are conducted on a HCCI mode of engine with compression ratio 17.5:1 and developing a pressure 200bar. The different parameters specific fuel consumption, brake thermal efficiency are determined. And, also emissions such as HC, CO, CO₂, NO_x and PM are determined.

Performance Tests

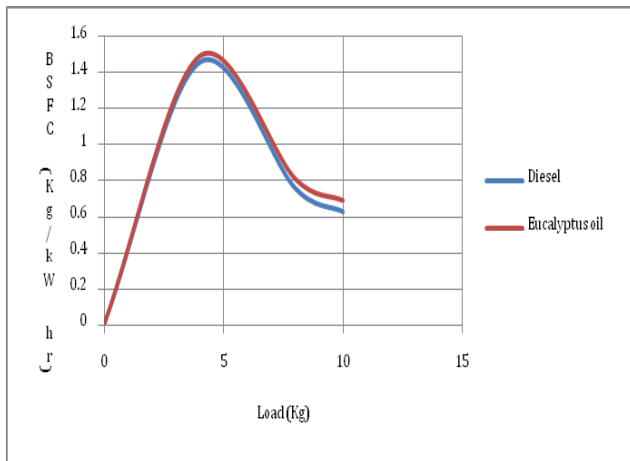


Fig. 4.1 Load v/s Brake Specific Fuel Consumption.

Fig. 4.1 shows the the graph of Load versus Brake Specific Fuel Consumption. It shows that the when the load decreases the fuel consumption is increases. The reason may be less Calorific value of Eucalyptus oil. Fig.4.2 graph of Load versus BrakeThermal Efficiency. The BTE of a diesel engine inversely proportional to bsfc. The blend of Eucalyptus biodiesel BTE decreases than the BTE of diesel fuel. It can be seen that the BTE of biodiesel blends is lower than that of Diesel.

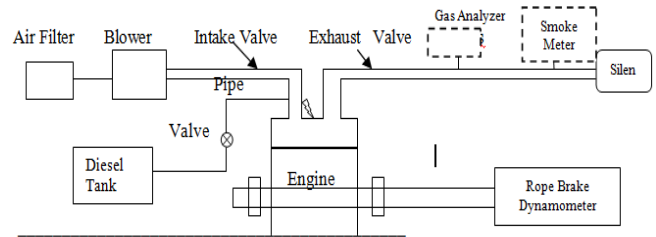


Fig.1: Schematic view of Experimental setup.

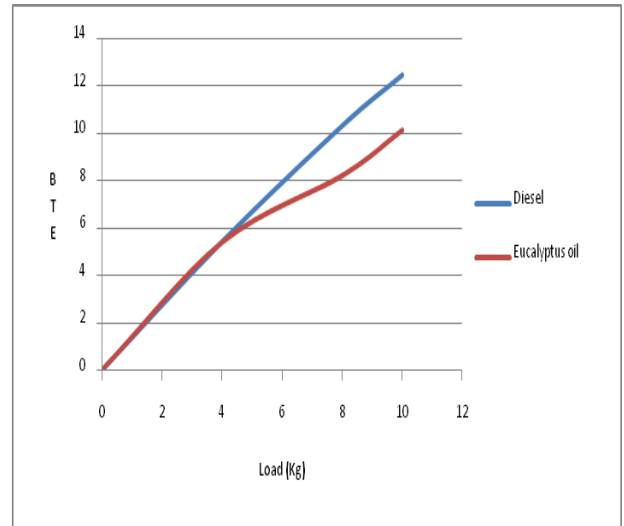


Fig. 4.2: Load v/s Brake Thermal Efficiency.

Emission Tests

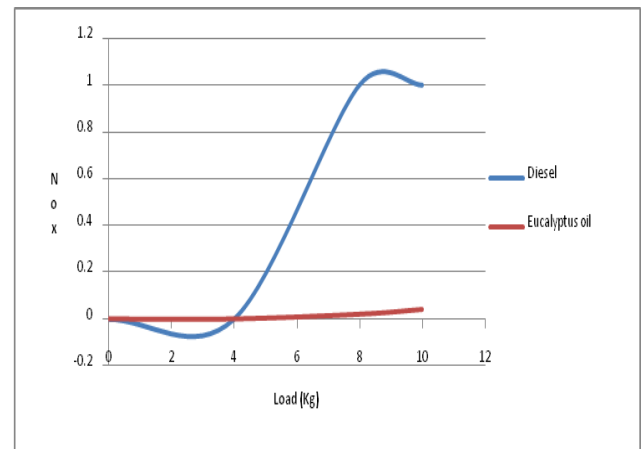


Fig. 4.3: Load v/s Oxides of Nitrogen.

Fig. 4.3 shows the graph of Load versus Oxides of nitrogen. It can be seen that, the NO_x emissions of Eucalyptus biodiesel blends are significantly less than the diesel at all loads of the engine. Fig. 4.4 shows the graph of Load versus Significant Hydrocarbons. It shows the Diesel fuel emissions are higher than that of Eucalyptus biodiesel blends. Fig. 4.5 shows the graph between Load versus Carbon monoxide. It shows that significant decreases in the CO exhaust of Eucalyptus compared to the Diesel.

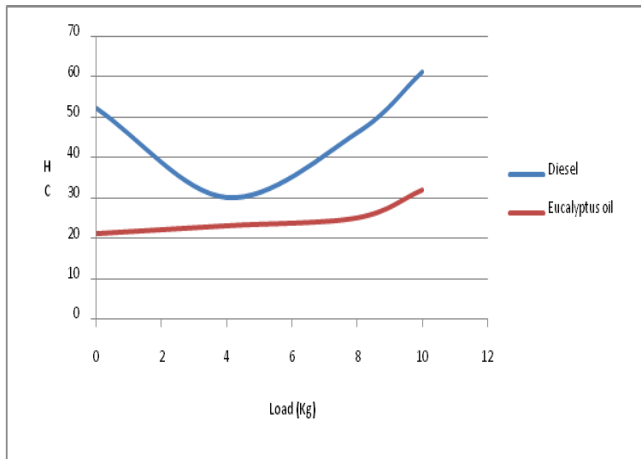


Fig. 4.4: Load v/s Hydrocarbons.

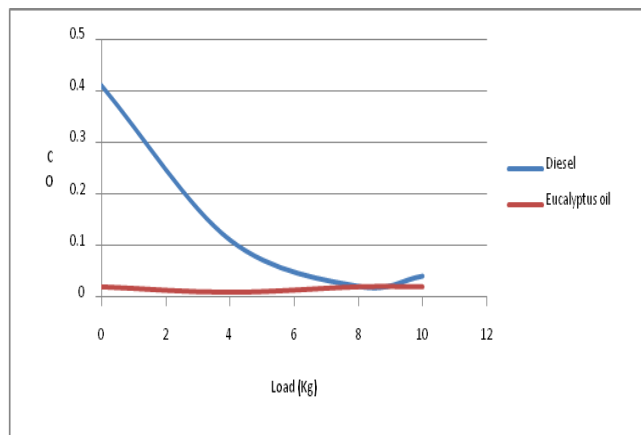


Fig. 4.5: Load v/s Carbon monoxide.

V. CONCLUSION

The following results are investigated:

1. The Eucalyptus biodiesel gets smoke cleaner and transparent compared to Diesel.
2. The plantation of Eucalyptus tree is over 1,000,000 hectares in India.
3. The fuel efficiency is observed to be lower with HCCI engine gives to higher fuel consumption, when the fuel introduced in the intake pipe.
4. The emissions of NOx are significantly reduced with fuel injection.

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