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Performance of IC Engine by using Simarouba Biodiesel

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***Abstract*—The simarouba biodiesel is considered as one of the alternative fuels to diesel. This has been taken up to identify the performance and emission characteristics using biodiesel. Necessary for alternative fuels which can be produced from resources available in the country such as biodiesel, alcohol, vegetable oils etc. This paper reviews the characterization, production, work carried out in various countries. The paper also explains about greenhouse gas emissions, fuel usefulness, efficiencies infrastructure, easy accessible, economics, engine performance and emissions, effect on wear, lubricating oil etc. The mainly is observed on the same factors which are critical to the potential profitable use of these blends. Just like petroleum, biodiesel operates in CI engine, and require very little engine modifications because biodiesel has properties similar to mineral diesel. The use of biodiesel in conventional diesel engines results in substantial reduction in emission of unburned hydrocarbons, carbon monoxide and particulate. This paper focuses on performance of biodiesel in CI engines, combustion analysis on long-term engine usage, and economic feasibility.**

***Index Terms*— Alcohol; Biofuels; Performance; Combustion analysis.**

I. INTRODUCTION

A. *An Overview of Diesel Engine*

The internal combustion engine differs from the gasoline powered Otto cycle by using highly compressed, hot air to ignite the fuel rather than using a spark plug (compression ignition rather than spark ignition).

B. Combustion in C.I. Engine

The process of combustion in C.I. engine is fundamentally different from that in a S.I. engine. In the S.I. engine a homogeneous carbureted mixture of petrol vapour and air, in nearly stoichiometric or chemically correct ratio, is compressed in the compression stroke through a small compression ratio (6:1 to 11:1) and the mixture is ignited at one place before the end of the compression stroke (say before 30° before TDC) by means of an electric spark.

In C.I. engine, air alone is compressed through a large compression ratio (12:1 to 24:1) during the compression stroke raising highly its temperature and pressure. In the highly compressed and highly heated

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air in the combustion chamber (well above ignition point of fuel) one or more jets of fuel are injected in the liquid state, compressed to high pressure of 110 to 200 bar by means of a fuel pump. Each minute droplet as it enters the hot air (temperature 450-500°C and pressure 30-40 bar) is quickly surrounded by an envelope of its own vapour and this, in turn and after an appreciable interval, is inflamed at the surface of the envelope.

C. Simarouba (Simarouba Glauca) As Biodiesel

Simarouba glauca is a species of flowering that is native to in the, southern. Common names include Paradise Tree and Bitter wood. Its seeds produce an. The tree is well suited for warm, humid, tropical regions. Its cultivation depends on rainfall distribution, water holding capacity of the soil and sub-soil moisture. It is suited for of 10 to 40 °C (50 to 104 °F). It can grow at elevations from to 1,000 m (3,300 ft). It grows 40 to 50 ft (12 to 15 m) tall and has a span of 25 to 30 ft (7.6 to 9.1 m). It bears yellow and oval elongated purple colored fleshy . It can be propagated from seeds, grafting and technology. Fruits are collected in the month of April / May, when they are ripe and then dried in sun for about a week. Skin is separated and seeds are grown in to produce saplings. Saplings 2 to 3 months old can be transplanted to a plantation.

The tree forms a well-developed and dense evergreen canopy that efficiently checks , supports soil microbial life, and improves groundwater position. Besides converting into biochemical energy all round the year, it checks overheating of the soil surface all through the year and particularly during summer. Large scale planting in wastelands facilitates wasteland reclamation, converts the accumulated atmospheric into oxygen and contributes to the reduction of or. It is believed that the leaves and roots of this plant have an ability to fight against cancer cells. Simarouba glauca trees must be regarded as a sure source of 2nd Generation Biodiesel and the foundation around which a profitable business plan can be build for its ability to provide large amount of oil and its pure hardiness and stress handling ability. The Simarouba biodiesel meets all the three criteria any environmentally sustainable fuel must meet. These are social, technical and commercial.

The seeds from the Simarouba glauca tree contain in excess of 60% oil. The main use of the oil will be as bio fuel and the production of biodiesel. This oil can also be used for cooking and soap production. Once the oil has been extracted, the seeds can be used as a coagulant for water treatment. The trees will act as sinks for carbon dioxide and hence, the Simarouba glauca plantation will reduce the amount of this greenhouse gas in the atmosphere. The project has many other positive economic, social and environmental impacts. There are income generation opportunities that result from the project like the provision of goods and services to the plantation and its workers.As the biodiesel industry grows, honing a cost-effective and diverse feedstock supply out as a top challenge. There is a need to diversify the sources and methods used to generate biofuel products to achieve food security, energy security and sustainable development and carbon savings. Biodiesel producers are looking for alternative feedstocks which are non-agricultural and non-food crops. And Simarouba glauca has the ability to substitute the requirement of low cost feedstock with the potential for high oil seed production and the added benefit of an ability to grow on marginal land. These properties support the suitability of this plant for large scale vegetable oil production needed for a sustainable biodiesel industry.

Yield is a function of light, water, nutrients and the age of the Plant. Good planning, quality planting material, standardized agronomy practices and good crop management may increase the yield. Simarouba glauce will yield at Maturity as high as +3 tons Biofuel with proper nutrition and irrigation, which is an exceptional amount of oil from as agricultural crop.

Fig. 1. Simarouba glauca seeds, Simarouba glauca Plant

II. EXPERIMENTAL PROCEDURE

1) Switch on the mains of the control panel and set the supply voltage from servo stabilizer to 220 volts.
2) The main gate valve is opened, the pump is switched ON and the water flow to the engine cylinder jacket (300 liters/hour), calorimeter (50 liters/hour), dynamometer and sensors are set.
3) Engine is started by hand cranking and allowed to run for a 20 minutes to reach steady state condition.
4) The engine software Lab view optimized for engine analysis by Deepti Engineering Services, Bangalore is used for taking readings.

The engine has a compression ratio of 17.5 and a normal speed of 1500 rpm controlled by the governor. An injection pressure of 200 bar, 250 bar and 300 bar are used for the analysis. The engine is first run with neat diesel at loading conditions such as 6.5, 13, 19.5 and 26 N-m. Between two load trials the engine is allowed to become stable by running it for 3 minutes before taking the readings. At each loading condition performance parameters namely speed, exhaust gas temperature, brake power, peak pressure are measured under steady state conditions. The experiments are repeated for various load conditions for S10, S20 and S30 biofuel. With the above experimental results, the parameters such as total fuel consumption, brake specific fuel consumption, indicated specific fuel consumption, specific energy consumption, brake thermal efficiency, indicated thermal efficiency, mechanical efficiency are calculated. Finally graphs are plotted for these parameters against various load conditions for diesel and S10, diesel and S20, diesel and S30 bio-diesel. From these plots, performance characteristics of the engine are determined.

A. Experimentation

The experiments were conducted on a direct injection compression ignition engine for various loads and blends of biodiesel & pure diesel. Analysis of combustion characteristics and performance parameters like peak pressure, specific fuel consumption (SFC) and Brake thermal efficiency are evaluated.

III. RESULTS AND DISCUSSIONS

A. Performance Characteristics

B. Brake Power (Bp)

The variation of Brake Power with various engine load conditions for base and modified piston for diesel and S20 fuels is as shown in the following graphs. It is observed that Brake Power (BP) increases with load.

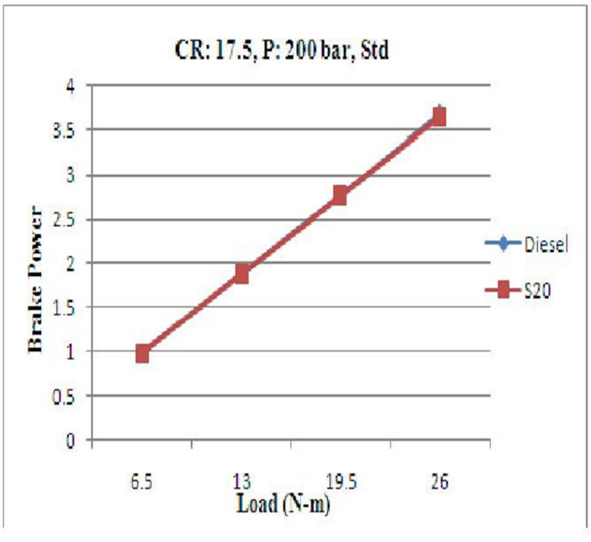


Fig 2. Variation of BP with Load for diesel and S20 Biodiesel

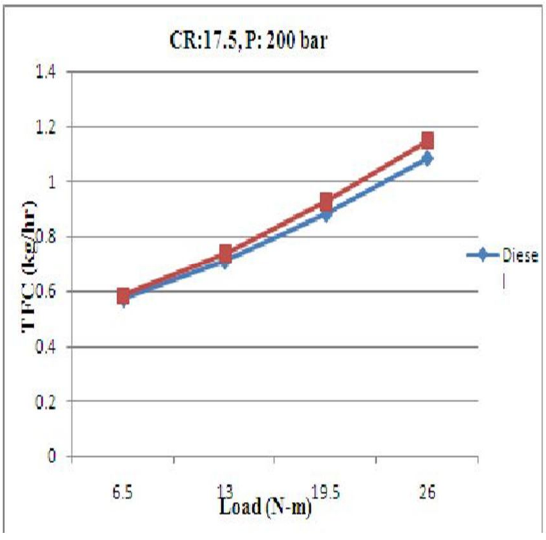


Fig 3.Variation of TFC with Load for S20 biodiesel normal

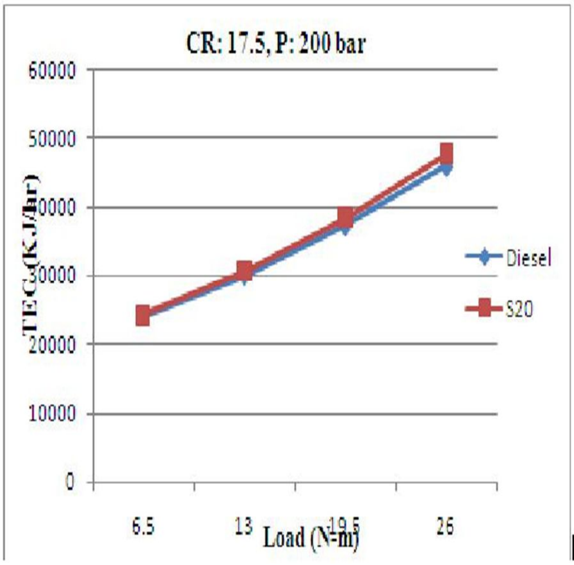
C. Total Fuel Consumption (Tfc)

The variation of Total Fuel Consumption with various engine load conditions for diesel and H20 fuels is as shown in the following graphs.

It is observed that Total Fuel Consumption (TFC) increases with load for diesel and H20 fuels in all the cases. It was further observed that TFC for S20 biodiesel is slightly lesser than normal diesel.

D. Total Energy Content (Tec)

The variation of Total Energy Content (TEC) with various engine load conditions for S20 biodiesel and normal diesel is as shown in the following graphs.



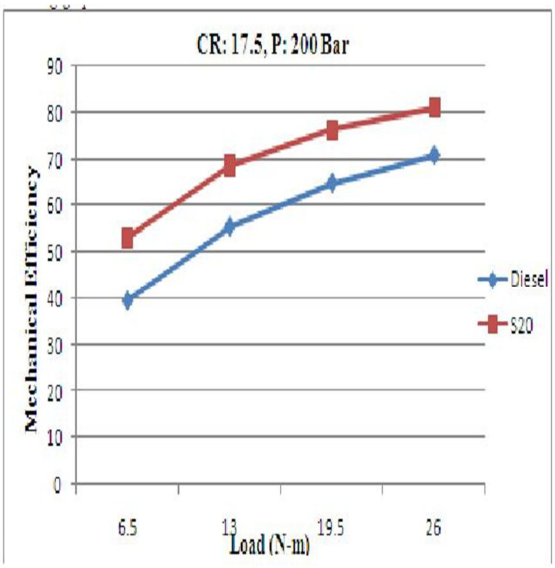


Fig 4. Variation of TEC with Load for S20 biodiesel and normal   Fig 5. Variation of ME with Load for S20 biodiesel &ND

The variation of Mechanical Efficiency with various engine load conditions for diesel and H20 fuels is as shown in the following graphs.the variation of Mechanical Efficiency with load for CR=17.5 and IP=200 bar for diesel and S20 fuels. It is observed that the mechanical efficiency is gradually increasing for both diesel and S20 blends.

Mechanical Efficiency gradually increases in both the cases. And it is observed that, mechanical efficiency is higher in case of S20 biodiesel.

IV. Conclusion

1. Brake Thermal Efficiency for modified piston at CR=17.5 for Diesel is increased by 3.25, 2.68 &1.84% at the loads 13, 19.5, 26 N-m respectively. Also brake thermal efficiency CR=17.5 for H20 is increased by 3.54% & 3.55% & 2.61% respectively at load 13,19.5,20 N-m.
2. Brake specific fuel consumption at CR=17.5 for diesel is decreased to around 8.2% at load 6.5N-m.
3. Mechanical efficiency at CR=17.5 for Diesel is increased by 3.98%, 15.66% & 6.60% at the loads 6.5, 13, 19.5 N-m respectively. Also at CR=17.5 for H20 is increased by 17.58%, 17.60%, 11.61% & 9.19% at the loads 6.5,13,19.5 & 26 N-m respectively .

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