Investigation of Simarouba Biodiesel as an alternative fuel for CI Engine : Review

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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.The depletion of world petroleum reserves and increased environmental concern have stimulated the search of alternative fuel which is to be environment friendly. Bio-fuels have the potential to become alternative fuel for fossil fuels. Biodiesel is renewable, reliable, biodegradable and regarded as a clean alternative fuel to reduce exhaust emissions. The simarouba biodiesel is considered as alternative fuels to diesel. The simarouba biodiesel is considered as alternative fuels to diesel. This review has been taken up to identify the performance and emission using simarouba biodiesel

KEYWORDS: Simarouba glauca seedsl, transesterification, Glycerine, density, viscosity, Performance, emmission analysis

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I. INTRODUCTION

The most harmful effect of our present day civilization is global warming and environmental pollution. With rapid industrialization and urbanization we are also making our planet unsafe for us and for the generations to come. The vehicle population throughout the world is increasingly rapidly. In India the growth rate of automotive industry is one of the largest in the world. It is quite evident that the problem cannot be solved with the conventional fossil fuels however stringent the emission control norms may be. The consumption of diesel fuels in India is 28.30 million tonnes which is 43.2% of the consumption of petroleum products. The requirement was met by importing crude petroleum as well as petroleum products. With the expected growth rate of diesel consumption of more than 14% per annum, shrinking crude oil reserves and limited refining capacity, India will be heavily dependent on imports of crude petroleum and petroleum products. From the standpoint of

preserving the global environment and to sustain from the large imports of crude petroleum and petroleum products from Gulf countries, alternate diesel fuel is the need of the hour. As world reserves of fossil fuels and raw materials are limited, it has stimulated active research interest in non petroleum, renewable and non polluting fuels. With this scenario the need for an alternate fuel arises to maintain the economy of the country. The world has been confronted with energy crisis due to the decrease of fossil fuel resources and the increase of environmental restrictions. Therefore attention has been focused on developing the renewable or alternate fuels to replace the petroleum based fuels for transport vehicles. There are several alternative sources of fuel like vegetable oils, biogas, biomass, primary alcohols which are all renewable in nature. Among these fuels, vegetable oils appear to have an exceptional importance as they are renewable and widely available, biodegradable and non-toxic, and environment friendly. In a country like India it is observed that biodiesel can be a viable alternative automotive fuel. Biodiesel is a fastest growing alternative fuel and India has better resources for its production the vegetable oils cannot be used directly in diesel engines as alternative fuel because of high viscosity of vegetable oils leads to problem in pumping and spray characteristics. The best way to use vegetable oils as fuel in diesel engines is to convert it into incomplete combustion. It is a fact that biodiesel is a safer, more economical and infinitely more environmentally friendly than the conventional petroleum diesel that the majority of people currently use. Simarouba Biodiesel is a vegetable oil-based fuel that can be used to replace diesel oil.

A.SIMAROUBA BIODIESEL

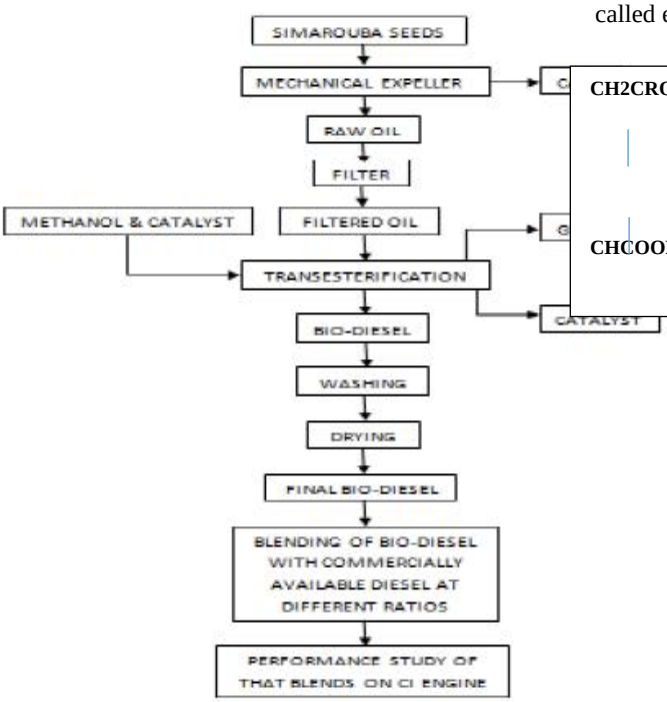
Simarouba glauca is a species of flowering that is native to in the, southern. Common names include Paradise Tree and Bitter wood. Its seeds produce an. The tree is well suited for warm, humid, tropical regions. Its cultivation depends on rainfall distribution, water holding capacity of the soil and 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 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. The flow chart for biodiesel production

Fig. 1. Simarouba glauca seeds, Simarouba plant



B. TRANSESTERIFICATION

It is most commonly used and important method to reduce the viscosity of vegetable oils. In this process triglyceride reacts with three molecules of alcohol in the presence of a catalyst producing a mixture of fatty acids, alkyl ester and glycerol. The process of removal of all the glycerol and the fatty acids from the vegetable oil in the presence of a catalyst is called esterification.

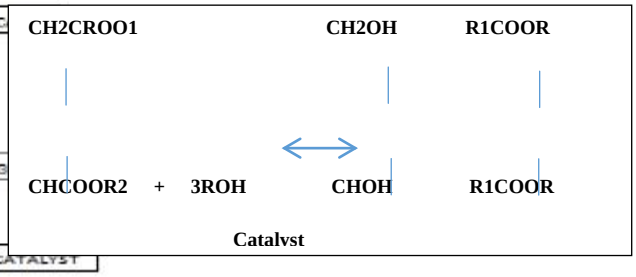


Fig 2 : Chemical Reaction

C. PROPERTIES OF FUELS

Properties	Diesel	Simarouba biodiesel (SOME)
Density (kg/m³)	827	865
Kinematic viscosity at 40˚C (cSt)	3.57	4.68
Flash point (˚C)	54	165
Calorific value (MJ/kg)	42	37.9 – 39.8
Cloud point (˚C)	-12	19
Pour point (˚C)	-16	14.2
Carbon residue (% w/w)	0.15	0.10
Acid value (mg KOH/gm)	-	5.34
Iodine number (gm/100gm)	-	83.4
Ash content (% w/w)	0.01	0.005

Table 1. Properties of diesel and simarouba biodiesel

LITERATURE REVIEW

VISHWANATH KASTURI, M. C. NAVINDGI

Conducted experiments on performance, combustion and emission characteristics of diesel engine using simarouba oil and its blends with the diesel. In this work the blends of varying proportions of simarouba biodiesel with diesel such as S20, S40, S60, S80 and S100 were prepared, analysed and compared the performance, combustion and exhaust emission with diesel using 5.2kW single cylinder, 1500 rpm, 4-s diesel engine.

Results showed that, the specific fuel consumption for simarouba biodiesel blends was higher than diesel for certain loads, but for higher loads, consumption rate remains almost constant. The air-fuel ratio of pure diesel was higher than the simarouba biodiesel and its blends and air-fuel ratio decreases as the load increases. Brake thermal efficiencies of all blends were lower at almost all load levels. Among the blends S20 is found to have maximum thermal efficiency of 25.01% at a brake power of 3.97kW while for diesel it is 27.84%. Exhaust gas temperature at full load was maximum for all the blends. The CO emission initially decreases at lower loads and sharply increases after 4kW of power for all test fuels. The S20 blend had more CO emission compared to all blends. The emission of HC was decreasing with increase in loads, but the blend S20 exhibits emission of HC similar to diesel and S100 blend had least emission of HC compared to other blends. NOx emission increased with the increase in percentage ratio of biodiesel. NOx emission for biodiesel and its blends was higher than that of diesel except S20 at lower loads.

SHAILESH GOLABHANVI, HARISH ASTAGI, OMPRAKASH HEBBAι

Conducted experiments on performance, emission and combustion characteristics of a single cylinder diesel engine operating on simarouba biodiesel and diesel fuel. In this work the blends of varying proportions of simarouba biodiesel with diesel such as S20, S40, S60, S80 and S100 were prepared, analysed and compared the performance, combustion and exhaust emission with diesel using 5.2kW single cylinder, 1500 rpm, fixed compression ratio 16.5:1, fixed injection pressure 200 bar and varying brake power.

Results showed that, as the brake power increases the brake thermal efficiency increases to an extent and then decreases slightly at the end. The brake thermal efficiency of S80 is nearer to the diesel, which shows S80 blend can be a favourable to existing diesel engine. The mechanical efficiency of diesel was slightly higher than the simarouba biodiesel. Mechanical efficiency of both diesel and biodiesel was equal at 20% of blend. Specific fuel consumption decreases at higher brake power. The specific fuel consumption for S80 blend was almost similar to diesel. The air - fuel ratio of pure diesel was slightly higher than simarouba biodiesel and its blends. The air-fuel ratio decreases as the load increases. The air-fuel ratio for diesel and biodiesel were equal at 20% blend. The air-fuel ratio for diesel was 20.1 at full load and for S20 blend it was 16.99 at full load. The brake mean effective pressure increases with increase in concentration of simarouba biodiesel. The exhaust gas temperature increases with increase in loads for all the blends. Volumetric efficiency of diesel was higher than simarouba blends. The NOx emission for biodiesel and its blends was higher than that of diesel except S80 at lower loads. HC emission for all biodiesel blends was less than that of diesel except at full load. CO_2 emission of simarouba blends at full load condition was lower than that of the diesel. The

CO emission for different blends of simarouba biodiesel decreases slowly and then increases exponentially at full load condition. Smoke emission of diesel at full load condition was higher than that of the blends of simarouba biodiesel.

VISHWANATH KASTURI, M. C. NAVINDGI

Conducted experiments on performance and emission characteristics of simarouba biodiesel and its blends on LHR engine. This work includes comparison between LHR engine and normal engine fuelled with blends of simarouba in the proportion of S0, S20, S40 and S100.

Results showed that, at maximum load the specific fuel consumption of LHR engine fuelled with biodiesel was higher than LHR engine fuelled with diesel and lower than normal engine fuelled with diesel and biodiesel. Air-fuel ratio decreases with increase in load in case of LHR engine. The S20 blend with LHR engine had higher brake thermal efficiency than normal engine. The CO emission in case of LHR engine for S20 blend was lower than normal engine. At full load HC emission levels were decreases for LHR engine fuelled with biodiesel than LHR engine fuelled with diesel and normal engine fuelled with diesel. At higher loads, NOx emission for LHR engine with biodiesel fuel was higher than normal engine with biodiesel.

SHARUN MENDONCA, JOHN PAUL VAS

Conducted experiments on influence of injection timing on performance and emission characteristics of diesel engine fuelled with 20% simarouba biodiesel.

Results showed that, for retarded injection timing brake specific fuel consumption was more for diesel compared to S20 blend at 20.5˚bTDC. For retarded injection timing diesel gives maximum brake thermal efficiency than S20 blend at 20.5˚bTDC. CO emission for diesel was less than S20 blend at 20.5˚bTDC injection timing.

Retarding injection timing causes more HC emission. NOx emission of S20 blend was higher than diesel at

20.5˚bTDC injection timing.

DILIP SUTRAWAY, Y. U. BIRADAR, V. V. KATTI

Conducted experiments on effect of fuel injection timing on performance of CI engine using simarouba biodiesel as fuel.

Results showed that, for all blends, the brake thermal efficiency increases with increase in load. Highest brake thermal efficiency was achieved for diesel at 23˚bTDC. The brake thermal efficiency was found to be lower for simarouba blends than diesel. For all blends, brake specific fuel consumption decreases with increase in load. The brake specific fuel consumption of S20 blend was best among all blends. At normal injection timing 23˚bTDC, the S20 blend was having higher brake specific fuel consumption compared to S40 and S100 at rated load. At advanced injection timing 26˚bTDC, the S40 blend was having higher brake specific fuel consumption compared to S20 and S100 at rated load. The CO emissions of simarouba blends were higher than that of diesel at rated load. The CO emissions were least for diesel and S100 at full load. At 20˚bTDC and 26˚bTDC the CO emissions were more than 23˚bTDC injection timing. The HC emissions were least for S40 and S100 at full load. At 20˚bTDC and 26˚bTDC injection timing, the HC emissions were less than 23˚bTDC injection timing. For diesel and S20 blend at 23˚bTDC injection timing HC emissions were high. For S20 blend at 26˚bTDC HC emissions were minimum. For S100 blend 20˚bTDC HC emissions were minimum. For rated load NOx emissions were higher for S100 than diesel at 23˚bTDC injection timing. For S20 and S40 blends at 23˚bTDC injection timing NOx emissions were low when compared to diesel. At 20˚bTDC and 26˚bTDC NOx emissions were less than 23˚bTDC injection timing for all blends. The exhaust gas temperature increases with increase in engine loading for all blends at 20˚bTDC was higher compared to 23˚bTDC and 26˚bTDC. At 23˚bTDC S40 and S100 blends were having minimum exhaust gas temperature. The smoke density increases with increase in blending. At rated load, 23˚bTDC smoke density for S20 was higher than that of diesel.

LAVA K. R., C. R. RAJASHEKHAR, VILAS WATWE

Conducted experiments on effect of modified (threaded) piston on performance, combustion and emission characteristics of diesel engine by using simarouba biodiesel. This paper relates the modification of engine combustion chamber design, for including turbulence to improve the combustibility of combustible mixture.

Results showed that, the standard piston produces higher cylinder pressure compared to threaded piston. The mass fraction burned was high with threaded piston than standard piston. The HC emission was decreasing with the increase in turbulence in threaded piston, which results in

complete combustion of fuel. The CO emission was high in case of standard piston than the threaded piston. The NOx emissions were slightly increased for S20 blend with threaded piston in comparison with the standard piston.

CONCLUSION

Simarouba biodiesel satisfies the important fuel properties as per ASTM specification of biodiesel. Engine works smoothly on simarouba methyl ester with performance compared to diesel operation. The simarouba biodiesel can be successfully substituted as alternative fuel for CI engine.

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