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Performance Analysis of Bio Diesel on Simarouba Oil

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***Abstract*— Global warming and air pollution are the biggest issue in the world. The more amount of air pollution is due to emission from an internal combustion engine. The major emissions from internal combustion engines are carbon monoxide (CO), Hydro-carbon(HC),carbon dioxide(CO_2) and oxides of nitrogen.**

The reduction of harmful emission from internal combustion engine can be achieved by using Biodiesel method, using Tamanu oil extraction of biofuel by Transesterification, using other experiments for processing.

Performance test were done by practically by that readings will calculated mathematically and plotted graphs for different readings.

Keywords:- Diesel engines, Transesterification, purification and drying, Biodiesel, single cylinder Kirloskar diesel engine.

I. INTRODUCTION

Biodiesel is the name of a clean burning alternative fuel, produced from domestic, renewable resources. Bio-diesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend, can be used in compression-ignition engines with little or no modifications. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulphur and aromatics. It's made through a chemical process called as transesterification. The biodiesel we produce would first have its properties gauged and later mixed with the diesel and a performance test of an engine running on this mixture would be carried out. This study is primarily to do with the field of automobile engineering. If we can increase the performances of the engine even by a little bit and at the same time reduce the emissions then this project would be worthwhile.

Following advantages

1.Biodiesel is potentially renewable and non - petroleum -based
2.Biodiesel combustion produces less greenhouse gases
3.Biodiesel is less toxic and biodegradable
Biodiesel can reducestailpipe emissions of PM, CO, HC, air toxics, etc.
4.Littlemodifications are needed for the traditional CI engine to burn biodiesel.

Biodiesel also has some of the disadvantages

1. Lower heating value, higher viscosity
2.It has got less storage stability and issues with material compatibility.
3.The major problem faced by using biodiesel is it produces slightly high concentration of NOx emission when compared to conventional diesel.

II.PROBLEMANALYSIS

While non-renewable sources of energy are usually utilized more commonly in this day and age than renewable energy sources, they tend to pollute the environment. Another disadvantage of non-renewable energy source is that they are not infinite and it has been proven by various studies that we are fast depleting our reserves of petroleum and other fuel products. Therefore to make up for these drawbacks of non-renewable energy sources we may have to consider renewable sources of energy like biofuels. Biofuels are usually produced from vegetable oils. Many scientists agree that vegetable oil can be used as an alternative to conventional diesel engine fuels. Research in recent times has been more concerned with the problems associated with using vegetable oil as a fuel because it essentially means that we would be converting food resources into fuel which may bring imbalance to global food reserves. Both the U.S. and European Union can afford to produce biodiesel from edible oils as they are net exporters. Somecountries like India cannot as theycurrently do not meet the demand for edible oils and must import .

Therefore we may have to consider alternative sources of biofuel. One such option may be to use non edible seeds to produce the biodiesel. [4] Onefeedstock recently gaining popularity for biodiesel production in India is Simarouba glauca because it is not considered an edible crop by the local population . It has a similar oil composition to popular feedstock , many parts of the plant can be used , the oil yield for hectare are considered to be very high , and it has the potential to grow on degraded lands. Below we can see a table highlighting the oil yield by Simarouba Glauca vs. otheroils.

Table 1.1 Oil Yield Table

Type of oil	Oil Yield (kg oil/ha)	OillYield (wt %)
Simarouba glauca	>1000	55-65 (seed kernel)
Jatropha curcas	1590	50-60 (seed kernel)
Soy-bean	375	20
Oil Palm	5000	20

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A. Simarouba has shown a very wide adaptability to diverse soil and climate conditions, it also has to its credit other desirablel traits such as drought tolerance , non-browsing by animals , and quick recovery from shock . Simarouba glauca is: between 52-54% oleicl acid, 27-33% stearic acid, and 11-12% palmitic acid, a composition that is very similar to that of several feedstock's already being used like Jatropha andsoybean

Introduction to Simaroubaglauca

Simarouba glauca is a species of flowering tree that is native to Florida in the United States, southern Florida, South America , and the Lesser Antilles. Common names include paradise- tree, dysentery-bark, and bitter wood. Its seeds produce an edible oil. Following are some of the characteristics of the plant:

- 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 temperature range of 10 to 40 °C (50 to 104°F).
- It can grow at elevations from sea level 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).

PROPERTIES OF SIMAROUBAOIL

We had also conducted some tests on the Simarouba seed oil in the Energy Conversion Lab at our college. We had conducted the flash and fire point test for the oil using the Pensky Marten Apparatus and the following results were obtained as seen in the table.

Flash Point	260^0C
Fire Point	310^0C

Table 3.1 Simarouba Oil Flash and Fire Points.

We had also conducted viscosity test for the oil using the Redwood Viscometer test. We had to first filter the oil before adding it into the apparatus. We conducted the tests

Sl. No	Temp of oil (^{0}C)	Specific Gravity 'S'	Density (kg/m³)	Kinematic Viscosity (m^2/sec)	Dynamic Viscosity (Ns/m^2)
1.	28	0.899	899	$8.159*10^{-5}$	0.0733
2.	38	0.888	888	$5.774*10^{-5}$	0.0512
3.	48	0.886	886	$3.817*10^{-5}$	0.0338
4.	58	0.884	884	$2.793*10^{-5}$	0.0246

at 4 different temperatures including room temperature i.e. 38, 48 and 58 degrees Celsius. The following results were obtained.

METHODOLOGY

The project was carried out in three phases as shown below.

1.In the first phase we gathered the seeds, decorticated them and extracted the oil from theseeds.

2.In the second phase we performed double acid transesterification and obtained the bio oil, after which we prepared the blends B20, B30 andB40.

3.In the third phase we conducted the performance and emission tests for the blends and compared the values to those of regulardiesel

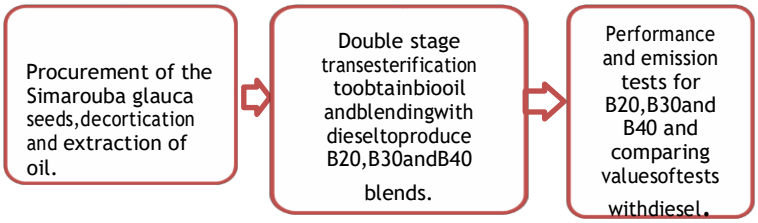

Fig 4.1 Phases of our project.

RESULTS AND DISCUSSIONS

1) 6.1 Properties of bio diesel blends

The following results were obtained for the bio diesel blends. It is found that the flash point and consequently the fire point all increase as more of bio oil is used in the blends. The density also increases as the density of the bio oil is greater than that of diesel and more amount of bio oil would lead to higher density of bio diesel mixture.

Property	B20	B30	B40
Density at 40°C(kg/m³)	817	825	840
Kinematic Viscosityat 40°C(m^2/s)	$6.159*10^{-6}$	$7.024*10^{-6}$	$6.847*10^{-6}$
Dynamic Viscosity at 40°(Ns/m^2)	$5.025*10^{-3}$	$5.829*10^{-3}$	$5.628*10^{-3}$
Flash Point(°C)	76	85.8	96.4
Calorific Value(KJ/Kg)	41960	41560	41420

PERFORMANCE TEST RESULTS

The performance test was first conducted on pure diesel at no load, 10%, 20%, 30%, 40% and 50% loads. After obtaining the required results for the performance test on the computer in the form of Excel spreadsheets and conducting the emission tests for the pure diesel at the different loads, we started conducting the performance test for the blends B20, B30 and B40 and the emission

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tests for the blends as well for different loads. A constant compression ratio was used for the performance test namely 17.5:1. The following results were found for the different fuels on the computer for the performance test.

Type of fuel	diesel					
Percentage load (%)	0%	10%	20%	30%	40%	50%
Torque in Nm	0	6.2871	12.524	18.856	25.148	31.43
Break Power in kW	0	1.225	2.4289	3.649	4.8266	6.035
Exhaust Gas Temperature in °C	82.111	146.14	169.59	191.104	209.67	235.58
Break Specific Fuel Consumption in kg/kWhr	0	0.8046	0.5232	0.4036	0.3393	0.3115
Break Thermal Efficiencyin %	0	10.352	15.9189	20.6394	24.54	26.74
Volumetric Efficiency in %	52.403	53.202	53.40325	53.58	53.96	53.93
MEAN EFECTIVE PRESSURE IN bar	2.1588	1.3778	2.0405	2.994	3.117	4.4364
IP in kW	4.44	2.791	4.114	6.023	6.219	8.857
Mechanical Efficiency in %	0	43.71	59.03	60.58	77.61	68.13
ISFC in kg/kWhr	0.2278	0.3532	0.3089	0.2445	0.2663	0.2118
Speed in rpm	1866	1838	1829	1825	1810	1811
Indicated Thermal Efficiency in %	36.575	23.587	26.967	34.067	31.634	39.261

Emission test result:

Type of fuel	B20 Biodiesel (20% bio oil and 80% diesel)					
Percentage Load	0%	10%	20%	30%	40%	50%
Co2 (% vol)	0.54	0.75	2.97	2.69	3.74	3.97
O2 (%vol)	17.73	17.33	15.94	15.5	14.79	13.8
HC (ppm)	24	25	28	28	26	24
NO(ppm)	141	189	448	476	526	592
CO (%vol)	0.25	0.22	0.15	0.17	0.12	0.14

SUMMARY OF RESULTS FOR PERFORMANCE &EMISSION TESTS

Thus for the performance test the following results are obtained regarding the properties of the blends at 50%load.

1..The indicated power is highest in B20 amongst all blends and is very close to that of diesel at 50%load.

2.The mechanical efficiency of B40 is the highest at 50%load.

3.The brake thermal efficiency of the B30 and B20 blends are similar at 50%load and are higher than the other blends and diesel and B30 shows the best indicated thermal efficiency for almost all loads till 50%load.

4.B20 exhibits the lowest exhaust gas temperature as compared to all the other blends and diesel itself, the highest being B40 at 50%load.

5.The B30 blend exhibits the lowest values of Brake Specific Fuel Consumptionl and Indicated Specific Fuel Consumption amongst all the blends and diesel at 50%load.

6.B40 blend exhibits best volumetric efficiency with B30 being second at 50%load.

The following results are obtained regarding the emission characteristics for the blends and diesel at 50% load.

1.B20 has the least CO2 emissions as compared to diesel and all other blends at 50%load.

2.B30 is shown to have the least HC emissions at 50% load as compared to all other blends anddiesel.

3.B30 has lower CO emissions than all other blends but has similar emissions as compared to diesel at 50%load.

4.All the biodiesel blends have lower NO emissions than diesel at 50% load but B40 has the least emissions of all the blends.

5.The oxygen content of the smoke for all blends are relatively the same at 50% load as that of diesel at thatload.

CONCLUSION AND SCOPE FOR FUTURE WORK

Thus from this project we have established that Simarouba oil based bio diesel can be a viable fuel for diesel powered automobiles.

Very minimal changes would have to be made in order to accommodate the new fuel such as a compression ratio of17.5:1. From the tests we have conducted in Dr. Ambedkar Institute of Technology regarding the performance and emission characteristics of the bio diesel blends as compared to regular diesel, we have found that the ideal blend for favorable performance and emission parameters is either B20 orB30.

An intermediate blend such as B25 may also be considered to get the best of both B20 andB30. There is room to improve on many aspects of the project such as the transesterification process in order to obtain a purer bio oil than what we had obtained. But overall the project has been a success in our eyes as we have proved that a

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Simarouba seed oil based bio diesel isviable. A few ways in which the viability of Simaroubaoil based bio diesel can be improved is by checking out other types of blends and/or mixing additives comprising of other oils to improve the performance of the bio diesel and also further reducing the emissions of the biodiesel.

Another method is conducting the experiment on different compression ratios. This is because higher the compression ratio, higher will be the pressure on the cylinder which in turn increases the temperature such that even bends with higher flash and fire points can be run by the engine.

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