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Investigation of Performance of Diesel Engine with different Compression Ratio and Biodiesel

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Abstract — In this research work prospects and opportunities of utilizing 100% biodiesel and increasing biodiesel-diesel blend ratio as fuel in diesel engine has been investigated by varying compression ratio. The properties of these were compared with the characteristics required for internal combustion engine fuels specially diesel engine. Experiments were performed for three compression ratio i.e.14,16 and 18 using biodiesel diesel blends i.e. B20, B30, B40, B60, B80 and pure biodiesel with load variation from no load to full load and compared with base cases i.e. engine using diesel as a fuel. Biodiesel was prepared from the raw honge oil (jatropha oil) by the trans-esterification process. The kinematic viscosity of the biofuel was found several times greater than that of diesel. This higher viscosity value of biofuel 7.12 mm²/s as compared to 4.5 mm²/s for diesel at 40°C leads to many problems in pumping, atomization and others that necessitated the trans-esterification process. Further investigations are made to study the sole effect of the use of the blends of PPME and diesel in diesel engines. The experiments are conducted in a diesel engine coupled with an exhaust gas analyzer to study the performance characteristics and the extent to which the jatropha oil could replace diesel.

Keywords— *Biodiesel, Biodiesel-Diesel Blend, Varying Compression Ratio.*

I INTRODUCTION

There is rapid decrease in the world petroleum reserves its affect on environmental pollution is increasing day by day by exhausted emissions. In this scenario the interest in this world to invent substitute fuels for the diesel engines. So there are vegetables oil is favorable option as it has many advantages. It is reusable, eco friendly, and cheaper to make and easily produce in villages, where there is no acute need for modern form of energy [4]. Some institution and research organizations they produced bio diesel with properties that very close to use of diesel. Such types of fuels are already in use due to compatibility, largely because of cheaper as compare to diesel and continued availability to the future. In addition the international pressure to reduce the carbon dioxide emitting hydrocarbons has made it essential to examine the properties of different green energy fuels, having potential in of using these in diesel engines [23]. While biodiesel has much gain over diesel fuel, but there are many problems that need to address, such as its higher flash point, high viscosity, and poor cold flow properties, lower calorific value, poor oxidative stability and sometimes its moderately higher secretion of nitrogen oxides. As a result many fuels are being scrutinized auxiliary for fossil fuels, especially diesel vegetable oils may give one such substitute and their potential has been test in the past few years by several researchers.

II Biomass scaffold

Biomass is characterized in many manners as said by field of discussion. For ecology and biological relevance, biomasses are standing the total sum of living organic in a given habitat, population, or sample. Rather than the energy and chemical industry, biomass also refers to the organic material on earth that has stored in sunlight in the form of chemical energy. The word “Biomass” consist of wood, wood waste, straw, manure

sugar cane, and many other by products from a collection of agricultural processes.

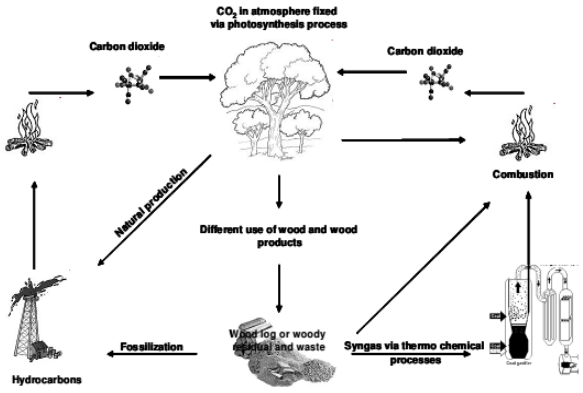

Figure 1.1: *Main parts of biomass transformation(source of internet)*

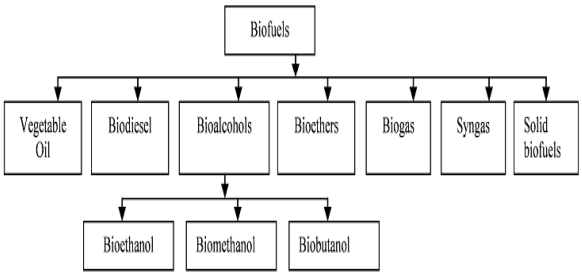

Figure1.2 Block diagram of various outcomes of biofuels.(source of internet)

III Properties of jatropa oil and diesel

Table 1.1 **Properties of diesel and jatropha oil**

Properties	DIESEL	Jatropha OIL
Density(kg/m³)	840	870
Specific gravity	0.840	0.870
Flash point(°c)	56	170
Calorific value(kj/kg)	43000	36100

IV Advantages of bio diesel

There are many technical advantages of bio diesel fuel:

- It extends engine life and reduces the need for preservation (bio-diesel have good lubricating qualities than fossil fuel)
- It is innocuous to handle, being minor harmful, major bio degradable, and having a higher Flash point,
- It reduces some exhaust emissions (although it may, in some circumstances, advance others).
- Bio diesel is an efficient, hygienic, 100% natural energy substitute to petroleum fuels. As well as the many advantages of bio diesel fuel include the following: safe for use in entirely conventional diesel engines, approach the same performance and engine robustness as petroleum diesel fuel, non-flammable and non-toxic, reduces tail pipe emissions, observable Smoke and noxious fumes and redolence.

Bio diesel as good with respect to diesel fuel in terms of sulfur content, flash point, odors content and bio-degradability

V Objective of the Work

In the existing thesis, biodiesel is extract from the raw honge oil (jatropha oil) by the trans-esterification method. The kinematic viscosity of the biofuel is most of the times greater than that of diesel oil. This high viscosity value of bio-fuel 7.13mm²/s as compared to 4.50mm²/s for diesel at 40°C leads to major threats in pumping, itemization and more that required the trans-esterification method. Additional investigations are made to study the sole effect of the use of the mixing of PPME and diesel in diesel engines. The research is performed in a diesel engine coupled with an output gas analyzer to means the performance characteristics and the extent to which the jatropha oil maybe replace by diesel.

VI Problem Formulation

These characteristics of biodiesel reduce the harmful emissions of unburnt hydrocarbon (HC), CO, and particles than the diesel fuel. Several researchers found increased NOx emission as compare to petrol- diesel and more worked on analyzing the performance of engine using different mixings of diesel biodiesel.

VII Experimental investigation

For whole project work, various parameters are varying among their respective range. The variable contents are fuel, compression ratio and the load condition. Table 3.1 shows the entire ignition for all the variable parameters.

The major parameter is fuel composition. The experiments were coming out with 100% diesel. Diesel-biodiesel mixing (B20, B40, B60 and B80) and 100% biodiesel Also other parameter i.e. loads and compression ratio also diverse as mention in Table 3.1 throughout experimentation. With all the mishmash of different load, test fuel and compassion ratio all the numbers of experiments were 120.

Table 1.2: Properties of diesel, methanol, jatropha biodiesel

S no.	Properties	Diesel	Methanol	Jatropha biodiesel
1	Density(kg/m³)	815	790	889
2	Calorific value(kj/kg)	43350	19700	39132
3	Kinematic viscosity @ 40 c(m²/sec)	4.30	0.7468	5.71
4	Cetane number	47	<5	52.8
5	Flash point(°c)	50	11	181
6	Oxygen content(% mass)	0	49.9	10.8
7	Latent heat of vaporization (kj/kg)	233	1178	250
8	Ignition limit (% vol) Lower Higher	1 6.0	7.3 36	- -

Table 1.3: Variable Parameters for Experiment

Fuel	Pure Diesel, B10, B20, B30, B40, B60, B80, Pure Biodiesel
Compression Ratio	12,14, 16, 18
Load (%)	0, 25, 50, 75, 100

Table 1.4 Specification of diesel engine

NAME OF THE MANUFACTURE	KIRLOSKER
RATED SPEED	1500 RPM
BRAKE POWER	3.68KW
EFFICIENCYOF GENERATOR	82.3%
FUEL USED	DIESEL
SOFTWARE USED	ENGINESOFT
STROKE LENGTH	110MM
DIAMETER OF CYLINDER	87.5MM
COMPRESSION RATIO	17.5
NOZZLE OPENING PRESSURE	200-225 BAR
NO. OF CYLINDER	ONE
NO. OF STROKE	FOUR STROKE

Eddy current dynamometer:

MODEL	AG 10
TYPE	EDDY CURRENT
MAXIMUM POWER	7.3 KW (1500-3000 RPM)

VIII REULT AND DISCUSSION

FUEL	DIESEL	BIO DIESEL	B20	B40	B60	B80
IGNITION DELAY	16.2	20	17.8	18.2	18.8	20
	15	19.5	16	17.8	18.3	19.2
	12.5	19.2	15.8	16.5	17.8	18.8
	11.5	18	14	15.8	16.5	18.4
	11	18.8	12	15	15.8	18
	9.5	17.6	10	13.8	15	17.2
	10	17	10.2	11	13	16.8

Table 1.5- This table shows ignition delay value of biodiesel and additive biodiesel

FUEL	DIESEL	BIO DIESEL	B20	B40	B60	B80
LOAD PERCENTAGE	0	0	0	0	0	0
	25	24	25	25	25	25
	45	45	45	42	45	46
	55	55	65	55	55	56
	60	62	70	60	60	63
	72	72	78	68	68	72
	74	80	80	80	80	80

Table 1.6- This table shows load percentage value of biodiesel and additive biodiesel

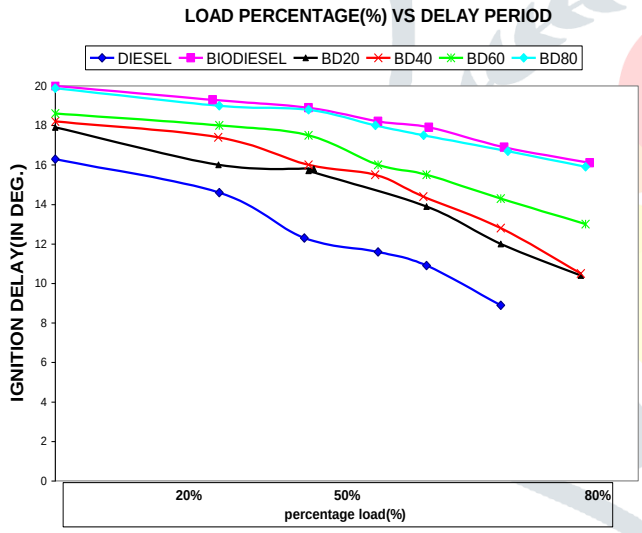

***Figure 5.1*:** Effect of load on ignition delay period for various fuels.

IX CONCLUSION

1) Jatropha oil can be one of alternate fuel for diesel engine. This has property very close to diesel. It is mixable with diesel fuel in any proportion and can be used as diesel fuel extender.

2) India is Agriculture based country; large portion of our waste and unfertile land can be used for karanja plantation so that large production of jatropha oil can be used for bio diesel production, will act as a future fuel

3) On comparing the physical and chemical properties of jatropha oil are quite similar to diesel. However its viscosity is higher.

4) Trans-esterfication process can reduce the viscosity of jatropha oil to a substantial level and admit it to be used in diesel engine.

5) Calorific value of jatropha oil is found to be low by 8% due to difference in chemical composition and difference of carbon- hydrogen contents

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