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Biodiesel as a Fuel in Compression Ignition Engine

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Abstract - *In this paper, we studied different possible fuel options with its properties and potential to diesel fuel in CI engine. As need and consumption of diesel in day to day life which causes increase in its price. Now we all are facing problem with quantity and quality with its price for normal human being. Over the past decade, the use of alternative fuel in diesel engines has been gaining interest in India. In the past few years, interest and activity around the world have grown to find an alternative to fossil fuels and alternative fuels. The oil fuel crisis and the import of fossil fuels have a major impact on the economy and development.*

In this work we suggested different biodiesel compositions with different percentage. Various tests are carried out on these fuels for the parameters like Indicated and brake power, indicated and brake thermal efficiency with torque output. We concluded this paper with B30 biodiesel as alternative to conventional pure diesel with all results.

Keywords: Biodiesel, Indicated and Brake Power, Indicated and brake thermal efficiency

1. INTRODUCTION

Increase in demand of petrol and diesel fuel in day to day is big problem for world due to its limited stocks. as the fossil fuels are non-renewable types of fuel the stocks of them are limited in nature. There is need to find alternative fuel other than petrol and diesel fuel. Research had made toward alternative fuel to find substitute for fossil fuel earlier.

Biodiesel is a renewable source of energy that can help reduce greenhouse gas emissions and minimize the "carbon footprint" of agriculture. It contributes less to global warming because the carbon in the fuel was removed from the air by the plant feedstock

One of the main reasons why we need Biodiesel is that it can be used in today's engines, infrastructures and vehicles without the need to make changes or smaller changes. Biodiesel can be stored, burned and pumped the same way as petroleum diesel fuel. It can also be used in blended or pure forms safely.

Increasing the investment in Biodiesels will result in a boost of growth in the economy. This means that there will be more jobs and new sources of income for farmers in the industry. Developing countries will benefit from the economic growth in the demand for world energy.

With the appropriate method of production, Biodiesel will produce a significant amount of greenhouse gas emission than is currently produced from fossil fuel. Biodiesel can help to improve energy security can help to improve energy balance through domestic energy crops. The plants are used to produce Biodiesel in replacement of imported crude oil. Biodiesel will also add to the overall national capacity to reduce the need for import oil.

Biodiesel, which can be used as an alternative diesel fuel, is made from renewable biological sources such as vegetable oil and animal fats. It is biodegradable, nontoxic and possesses low emission profiles. Also, the uses of bio-fuels are environmentally beneficial.

Biodiesel is a renewable fuel, has a simple production technology, low handling risks and emits low pollutants and can be used in the engine with some small modifications. It is widely accepted that biodiesel decreases the emission of carbon dioxide (CO2), and carbon monoxide (CO), particles and nitrogen dioxide (NO2), so there is a great scope in the investigation to use biodiesel as a fuel alternative.

1.1 Need of alternative fuels

1. Conventional fuels are going run out

One day, our sources for traditional fuels including petroleum would be depleted. Owing to the fact that these fuels are typically not renewable, a lot of people are worried that a day would come when the demand for these fuels would be more than the supply

2. Reduce pollution

The use of alternative fuels considerably decreases harmful exhaust emissions

3. To protect against global warming

According to a commonly accepted scientific theory, burning fossil fuels was causing temperatures to rise in the earth's atmosphere (global warming).

Produced from Renewable Resources Biodiesel is a renewable energy source unlike other petroleum products that will vanish in years to come. Since it is made from animal and vegetable fat, it can be produced on demand and also causes less pollution than petroleum diesel

1.2 Problem Statement:

The necessity of alternative fuel is most important because the pollution in automobile using conventional petroleum fuels is more.

Increase in demand of petrol and diesel fuel in day to day is big problem for world due to its limited stocks. as the fossil fuels are non-renewable types of fuel the stocks of them are limited in nature.

These limited resources are highly concentrated in certain region of the world. So, countries not having these resources are facing energy/ foreign exchange crises mainly due to the import of crude petroleum. Hence, it is necessary to look for alternative fuels which can be produced from resources available locally with in the country such as alcohol, biodiesel, vegetable oil etc.

1.3 Jatropha plant Image

Fig 1: Jatropha Plant

1.4 Blend

A mix of two or more fuels or chemicals or oils to mixed fuel is called as blend. Blends of biodiesel and conventional hydrocarbon-based diesel are most commonly distributed for use in the retail diesel fuel marketplace. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix

1. B12% (12% Biodiesel + 88% Pure diesel)
2. B18% (18% Biodiesel + 82% Pure diesel)
3. B24% (24% Biodiesel + 76% Pure diesel)
4. B30% (30% Biodiesel + 70% Pure diesel)
5. B36% (36% Biodiesel + 64% Pure diesel)

Blends of 20% biodiesel and lower can be used in diesel equipment with no, or only minor modifications. Biodiesel can also be used in its pure form (B100), but may require certain engine modifications to avoid maintenance and performance problems

1.5 Properties

Property and Effects

1. Cetane Number
2. Volatility
3. Viscosity
4. Sulfur Content
5. Flash Point
6. Carbon Residue

1.6 Raw material for Biodiesel

1. Vegetable oil
2. Alcohol
3. Catalyst

1.7 Performance Parameters of the C. I. Engine

1. Brake power

The power developed by a motor and measured on the output shaft of the motor is called the brake force of the motor.

2. Indicated Power

The total power developed in the combustion of fuel in the combustion chamber is called the rated power

3. Friction power

It is defined by the difference between the rated power and the braking power of the engine

4. Mean Effective Pressure

Mean Effective Pressure is defined as the average pressure which is acting on the piston through the power stroke.

5. Specific output

Specific output of an engine is defined as the brake power unit of piston displacement.

6. Fuel consumption

Amount of fuel consumed per unit time is called as the fuel consumption

7. **Fuel air ratio**

It is the ratio between the mass of the fuel and the mass of air in the fuel air mixture called the air fuel ratio

8. **Automobile efficiency:**

It is the ratio of brake power to the Indicated power of the engine

9. Brake Thermal efficiency:

Brake thermal efficiency is the ratio of brake power (B.P.) to power (product of fuel mass flow and non energy content of fuel).

10. Indicated Thermal efficiency:

Indicated thermal efficiency may be acquired from indicated electricity to the power furnished by way of the fuel.

2. EXPERIMENTAL SETUP

In this chapter, we have studied and discussed about experimental setup Engine setup testing procedure.

We are using of IC Engine combustion analysis software.

Table- 1: Engine specification

Engine	Single cylinder, 4 stroke, water cooled, diesel, rated strength 5.2 KW, pace 1500rpm, bore 87.5mm, stroke 110mm, compression ratio 17.5 capability 661 cc.
Dynamometer	Hydraulic or eddy current type
Fuel tank	10lit cap with graduated glass fuel

	metering column
Air box	With orifice meter and manometer
Rota meter	For water flow measurements

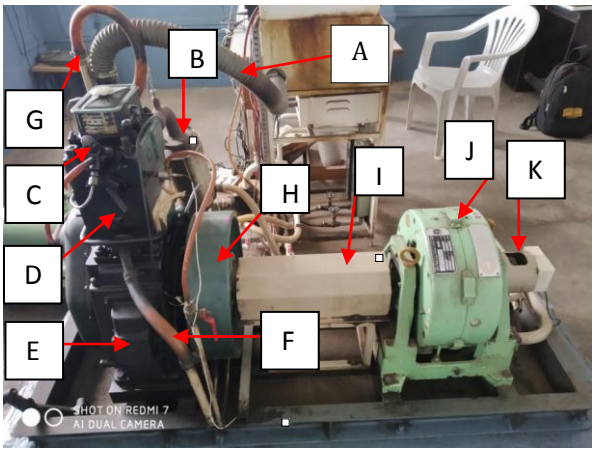

Fig - 2 Single cylinder Engine

A- Fuel inlate
B- Exhaust muffler
C- Injector
D- Cylinder block
E- Crank case
F- Hot water in
G- Hot water out
H- Flywheel
I- Connecter shaft
J- Dynamometer
K- Tachometer

3. RESULTS AND CONCLUSION

3.1 Result:

In this chapter various parameters of Biodiesel have been compared with Pure Diesel. Graph of Indicated thermal efficiency (IThEff) and brake thermal (BThEff) efficiency vs. load are plotted. In this study we have compared B12%, B18%, B24%, B30%, B36% with the Pure Diesel to conclude if Biodiesel is better than Pure Diesel or not based on the output of our study.

Pure Diesel

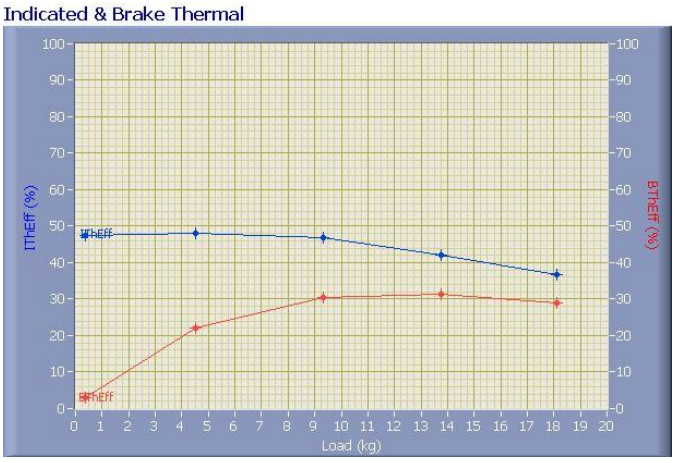

Chart – 1: Pure Diesel reading

As a load is increase a IThEff of pure diesel is decrease and BThEff is increase for a limited load.

Table - 2: Readings of Pure Diesel

Load (kg)	IThEff (%)	BThEff (%)
0.35	47.57	2.92
4.50	47.98	22.11
9.33	46.72	30.39
13.76	41.99	31.33
18.11	36.75	28.87

12% Biodiesel

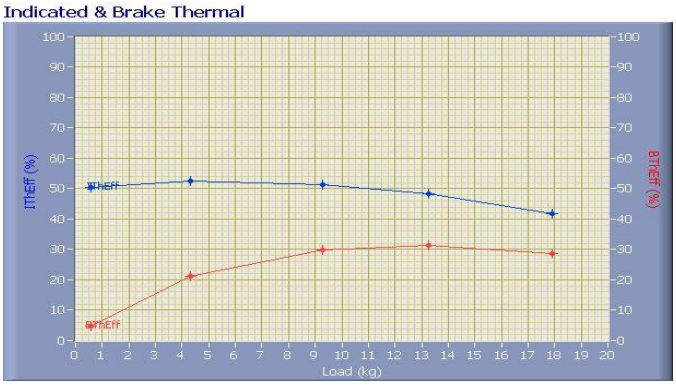

Chart No – 2: 12% Biodiesel readings

Fig shows the graph of the Brake and Indicated thermal efficiency Vs load% for the compression ratio 17.50. The Brake thermal efficiency of the mixture is increase as per load increase but less than the pure Diesel. As load is increase Indicated thermal efficiency decrease compared to the pure Diesel.

Table - 3: Readings of 12% Biodiesel

Load (kg)	IThEff (%)	BThEff (%)
0.60	50.45	4.89
4.31	52.46	21.16
9.28	51.41	29.98
13.25	48.36	31.43
17.92	41.64	28.59

18% Biodiesel

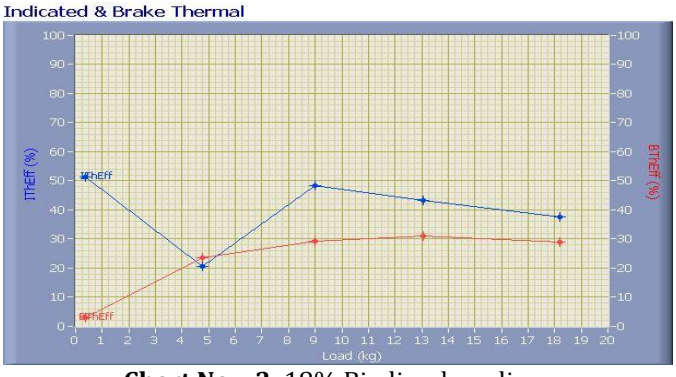

Chart No – 3: 18% Biodiesel readings

Graph of the Brake and Indicated thermal efficiency Vs load% for the compression ratio 17.50. The Brake thermal efficiency of the B18% mixture is increase as per load increase but less than the pure Diesel. For a B18% Indicated thermal efficiency is suddenly decrease or increase and as per load increase value of it is decrease than the pure Diesel.

Table - 4: Readings of 18% Biodiesel

Load (kg)	IThEff (%)	BThEff (%)
0.38	51.35	3.08
4.77	20.68	23.58
8.98	48.41	29.25
13.06	43.28	31.15
18.21	37.71	28.99

24% Biodiesel

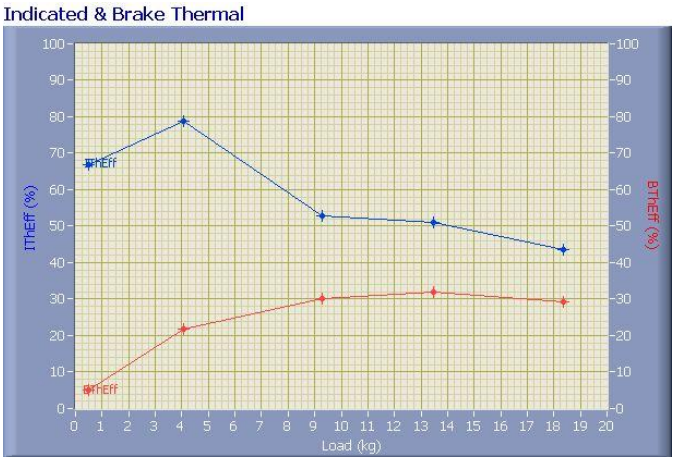

Chart -4: 24% Biodiesel readings

Fig shows the graph of the Brake and Indicated thermal efficiency Vs load% for the compression ratio 17.50. The Brake thermal efficiency of the mixture is increase as per load increase but less than the pure Diesel. At a less load is Indicated thermal efficiency is more than the pure Diesel but load is increase the indicated thermal efficiency is less than the pure Diesel. For a 24% Biodiesel IThEff is not a stable.

Table - 5: Readings of 24% Biodiesel

Load (kg)	IThEff (%)	BThEff (%)
0.51	66.86	5.02
4.05	78.74	21.93
9.29	52.85	30.13
13.48	51.12	31.97
18.34	43.66	29.38

30% Biodiesel

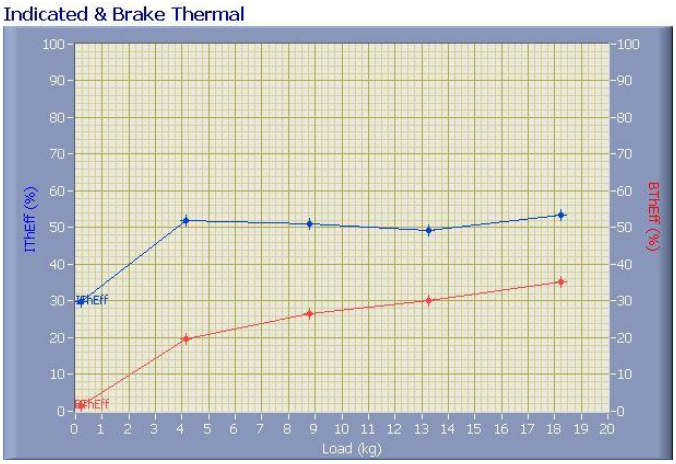

Chart – 5: 30% Biodiesel reading

Fig shows the graph of the Brake and Indicated thermal efficiency Vs load% for the compression ratio 17.50. The Brake thermal efficiency of the mixture is increase as per load increase and it is more than the pure Diesel. As load is increase Indicated thermal efficiency also increases as compared to the pure Diesel.

Table - 6: Readings of 30% Biodiesel

Load (kg)	IThEff (%)	BThEff (%)
0.19	29.88	1.52
4.13	52.02	19.57
8.80	51.12	26.46
13.26	49.13	30.05
18.23	53.30	35.35

36% Biodiesel

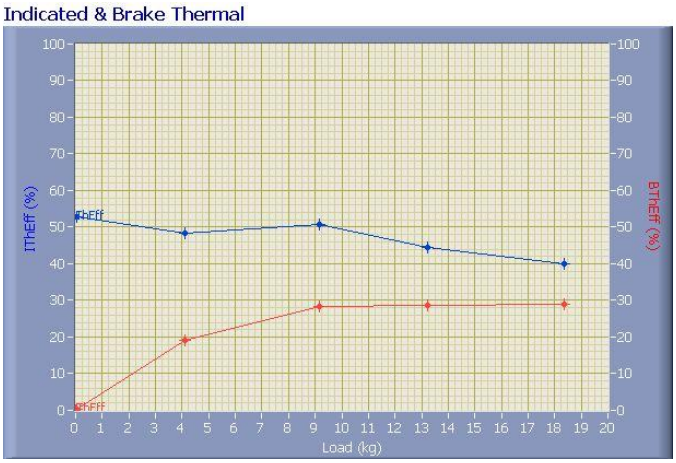

Chart - 6: 36% Biodiesel

Fig shows the graph of the Brake and Indicated thermal efficiency Vs load% for the compression ratio 17.50. The Brake thermal efficiency of the mixture is increase as per load increase but less than the pure Diesel. As load is

increase Indicated thermal efficiency decrease more than the pure Diesel.

Table - 7: Readings of 36% Biodiesel

Load (kg)	IThEff (%)	BThEff (%)
0.05	52.79	0.40
4.12	48.41	19.04
9.14	50.77	28.34
13.24	44.54	28.79
18.37	40.14	28.91

SSS3.2 Observation:

Table - 8: Comparison of Pure Diesel & B30%

IThEff (%)		BThEff (%)	
Pure Diesel	B30%	Pure Diesel	B30%
47.57	29.88	47.57	29.88
47.98	52.02	47.98	52.02
46.72	51.12	46.72	51.12
41.99	49.13	41.99	49.13
36.75	53.30	36.75	53.30

Why B30%?

Our tests have yielded the following results:

When compared with all other compositions of Biodiesel, B30% has given the maximum output in terms of both Brake Thermal efficiency and Indicated Thermal efficiency. High value of Brake thermal efficiency means more power output with minimum consumption of fuel.

3.3 Conclusion:

1. As Jatropha oil is non-edible, it is cheaply and abundantly available.
2. We can use a Jatropha biodiesel fuel in C.I. engines.
3. From the results the testing it is concluded that the B30% is giving better results for performance in BThEff, IThEff of engine as compared to other Biodiesel blends and pure diesel.
4. B30% gives more power output with minimum consumption of fuel.
5. Biodiesel is a superior lubricant and can restore the lubricity of diesel.
6. In this project we take readings on a different type of parameters.

4. References:

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4. Keywords: Jatropha biodiesel; Blending Properties; Performance Parameters.