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EFFECT OF SUPERCHARGING & INJECTION PRESSURE ON ENGINE COMBUSTION CHARACTERISTIC OF KARANJA BIODIESEL BLEND

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ABSTRACT

When increasing the fuel price, increasing on the addition of on road vehicles, very fast depleting petroleum resources and continuing accumulation greenhouse gases are the main reasons for the development of alternative fuels. Many alternative sources of blend fuels are identified and tested successfully in the existing engine with and without engine modification. However, so the research is still continuing in this field to find the best alternative fuel for the existing diesel fuel. It is feasible to use alternative sources of fuel in diesel engine partially which is proved by various researchers. The all systems are developed diesel engine is made for diesel and its all systems are developed for diesel fuel only. Also its parameters are optimized for diesel engine. If we use blend of diesel and other supplementary fuel, then it will not give satisfactory performance as per our requirement. So, it is required to optimize parameter for blended fuel. We use Karanja oil as a biofuel & used to find out effect on performance of engine. Karanja curcas as a non-edible methyl ester biodiesel fuel source is utilized to run single cylinder, variable compression ratio, and four-stroke diesel engine. Combustion characteristics as same as engine performance are measured for various biodiesel – diesel mixes. The properties of fuel biodiesel for example kinematic viscosity, calorific value, flash point, carbon deposit and specific gravity were found. The performance and emission characteristics are additionally influenced by different working parameters like compression ratio, injection pressure and injection timing. Our research deals with effects on engine fueled with diesel, mix of diesel with biodiesel and simply on biodiesel with a view to give a stage to correlation of the parameter on different fuels. Impact on Brake Specific Fuel Consumption, Brake Thermal Efficiency, Smoke haziness, NOx and CO outflows and Exhaust Temperature have been studied and exhibited. The results of trial examination with biodiesel mixes were compared with that of standard diesel.

The main parameter used in this experimental work is achieved by varying engine load with change in inlet air pressure with the help of air compressor. The experiments were carried out with 100% diesel and 100% Karanja biofuel & 50% blend Karanja bio oil with diesel. The measuring parameters are in two categories, performance and emission. In performance parameters BTHE, ITHE, mechanical efficiency, SFC, FC and in emission parameters CO, HC, CO2 and NOX are being found out and analyzed. Optimum specific fuel consumption was obtained for D0B100 when engine run at supercharged condition compared to diesel, which is nearest to the diesel fuel. The Brake thermal efficiency of D0B100 Karanja biodiesel blend is more among all other blends at all loads which is slightly greater than the diesel fuel. The mechanical efficiency of all blends are less than diesel fuel. It is concluded that the D50B50 blend have highest mechanical efficiency at engine supercharging condition is 41.43 % at low injection pressure at higher load than all among blends as well as diesel. With supercharging condition Karanja biodiesel & its blend with diesel have considerable lesser Emission of HC, CO, CO2, NOX as compared to diesel.

Keywords: *Karanja, Biofuel, Thermal Efficiency, BTHE, ITHE, SFC.*

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INTRODUCTION

Continuously increasing in fuel value, continuous increase on road vehicles, quick draining petroleum resources, the greenhouse effect and ozone depletion are the main reasons for the evolution of alternative fuels. Many optional or blend fuels are recognized and tried effectively in the current engine with and without engine adjustment. However, research is as yet proceeding in this field to locate the best option fuel for the current diesel fuel. It is feasible to use alternative sources of fuel in diesel engine partially which is proved by various researchers. The diesel fuel is only used for all the diesel engines. We got the optimized parameters of diesel fuel for diesel engines now if we mix another fuel with diesel we will not get the appropriate results as we got with pure diesel so it is important to optimize the parameter for blended fuel. The objective of our research is to optimize our parameter which gives maximum performance. For achieving desired result, it is required to perform number of experiments with different Compression Ratio at different Load condition. It gives the optimized Compression Ratio & Engine Load of engine to get better performance.

LITERATURE REVIEW

S. Murugan et al. (2008) they examined on the execution, outflow of the diesel engine utilizing by refined tire pyrolysis oil mixes. From the trial work did it is watched that the engine can keep running up to 90% DTPO and 10% DF (DTPO 90). Engine neglected to run tastefully with 100% DTPO. Brake thermal efficiency increments with the rate of DTPO mixes however lesser than DF. The start Parameters, for example, warm discharge rate, chamber top weight, and greatest rate of pressure rise additionally analyzed. Brake thermal efficiency of the engine expanded with increment in TPO blend concentration than DF. Furthermore lessening in NOx emission (Murugan, Ramaswamy, & Nagarajan, 2008).

Orkun Ozener (2012) he examined on the effects of soybean biodiesel on a diesel engine execution, outflow and burning qualities. Investigation was completed by soybean oil and used its mixes (B10, B20, and B50) were thought about. Biodiesel gave critical decreases in the CO and unburned THC. The NOx and the CO2 discharges expanded somewhat. The burning examinations demonstrated that the biodiesel added to the traditional diesel fuel diminished the start delay and lessened the premixed peak (Ozener, 2012).

Yasin et al. (2013) they considered on physical characteristics of fuel and biodiesel mix fuels with alcohol and added its substances. Properties correlation were been made between mineral diesel, B100, B20 and B20 liquor mix fuels. The outcomes demonstrate that in B20 mix fuel the nearness of alcohol diminishes the consistency and thickness of biodiesel fixation when mixing with mineral diesel. On other hand, a critical increment in Cetane number as a consequence of an expansion in alcohol focus in the biodiesel mix powers (Yasin et al., 2013).

Hifjur Raheman et al. (2013) they investigated and performed the diesel engine with mixes of biodiesel and high speed diesel. A 10.3-kW single-cylinder water-cooled coordinate infusion diesel engine was assessed utilizing mixes the biodiesel (B10 and B20) and obtained from a blend of mahua and simarouba oil with the ratio of 50: 50 with high speed diesel (HSD) as far as brake particular fuel utilization, brake thermal efficiency, exhaust gas temperature and

outflows for example CO, HC, and NOx with an expansion in engine load and BSFC diminished. The CO and HC emissions are lessen and NOx discharge expanded when worked with biodiesel mixes. As contrasted and HSD-fueled engine, lesser carbon stores on the in-cylinder parts, (for example, cylinder head, cylinder crown, and fuel injector) were watched for the B10 fueled engine because of better ignition of biodiesel mix (Raheman, Jena, & Jadav, 2013).

KARANJA

Among all the trees Karanja is similar to the neem tree. The leaves of all the trees are not eaten by cattles goats etc. The leaves contains 18% crude protein 43% dry matter 50% vitro dry matter digestibility,62% neutral detergent fibre. For animal feed the press cake (seed residue) after oil extraction is not good for use. It contains several toxic like 1.25% karanjin, and 0.85% pongamol alkaloid, resin, and sugar. Even it has high protein. This toxins are removed during solvent extraction of oil from cake with hexane because toxins are soluble in oil. For compound cattle feed de-oiled cake is used. It cannot replace more than 75% but can be used as a short term substitute for other protein sources. It is good organic manure which is used for sugarcane, coffee, oranges and paddy as it contains nitrogen 5.1% phosphorous 1.1% and potassium 1.3%.It helps to vanish red ants and is good for damage control. It has also chemical property which adds nitro group to an organic compound and has ability to blend with nitrogeneous fertilizers. Wind energy, geothermal energy, ocean energy, water power are different forms of renewable energy. In future the energy from bio fuels would be the strong source of energy. From non renewable source of energy we also get the energy which is much higher the sources are from fossil fuels like oil, natural gas, and coal. The major pollution in air, water and atmosphere is because of use of these fossil fuels. After Europeon Unions and China India is the largest importer of edible oil. European Unions, China and India is the largest consumer in the world. The demand for edible oil is increasing in India because the consumption rate, per capita income, and increasing population. Vegetable oil, biogas, ethanol methanol are the various alternative fuels that were tried instead of hydrocarbon. Among all these alternative fuels vegetable oil is preferred for use. The inventor of diesel fuel Rudolph has experimented on different fuels during the discovery of diesel fuel. The production of bio fuels is not suggested by the edible oils because it doesn't have world wide acceptance due to environmental degradation, energy security, rural employment and agricultural economy. Biological material like plants, agricultural waste undergoes chemical processes to produce bio fuels. Bio fuels are source of renewable energy are produce from trees. By analysing the economics and emissions we can use biodiesel as a pure fuel or blend with petroleum diesel. Edible oils and non edible vegetable oils, animal fats, wasted frying oils which are renewable sources are used to produce bio diesel which is an alternative fuel for diesel. Biodiesel is free from sulphur, rich in oxygen, non toxic, bio degradable and a renewable source of energy. Among all the alternative fuels bio fuels from vegetable oils are found best due to following reasons.

- In diesel engine biodiesel can be used without changing the design of engine
- Biodiesel does not contain sulphur, aromatic hydrocarbons metals. It is completely made by vegetable sources.

- Biodiesel fuel is rich in oxygen.
- Biodiesel reduce the emissions of carbon monoxide
- Biodiesel has the lubricating property which improves the life of the diesel engine.
- Energy security and economic independence is improved because biodiesel is produced from renewable vegetable oils.

Figure 1: Karanja Tree with fruits

PROPERTY OF KARANJA BIODIESEL

Table 1: Comparisons of Properties of Karanja Biodieselv/S Diesel

S. No.	Properties	Karanja Biodiesel	Diesel
1	Density@ 150C	0.9358	0.850
2	Viscosity@ 400C	38.8	2.6
3	Flash Point	212.0	70.0
4	Cloud Point	2.0	-16
5	Pour Point	-4	-20
6	Water Content	<0.05	0.02
7	Carbon Residue	0.8	0.17
8	Acid Value	16.8	0.35
9	Calorific Value	8742	4290

EXPERIMENTAL SETUP AND METHOD

In this arrangement there is single cylinder engine. Power is generated in four stroke and this engine can use multi fuels. This experimental arrangement is done for research work where load to the engine is given by eddy type dynamometer. In this arrangement we can run the engine by changing the fuels by some modifications. This arrangement consists of tilting cylinder block, which is helpful in changing the compression ratio without stopping the engine. For research work we can do the changes where it is necessary.

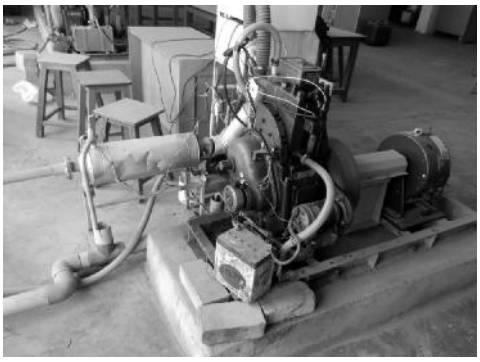


Fig. 2: Experimental Setup

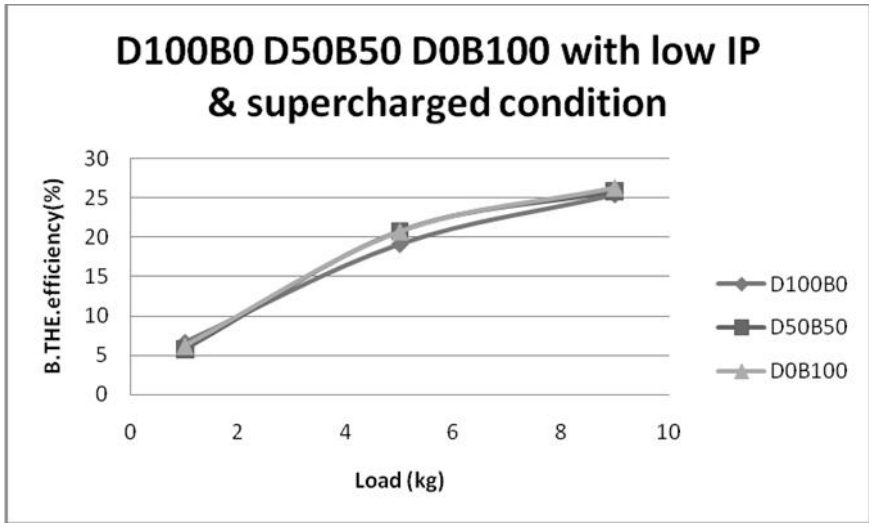
Table 2: Engine Technical Specifications

Model	TVI
Make	Kirlosker oil Engines
Type	Four stroke, water cooled, Diesel
No. Of cylinder	One
Bore	87.5 mm
Stroke	110mm
Combustion principle	Compression ignition
Cubic capacity	77.5 kg/cm2
Direction of rotation (Side)	Clockwise (Looking from flywheel end
Fuel timing for std. Engine	0 to 25 BTDC
Power	3.5 kW @ 1500 rpm
Valve timing	
Inlet opens BTDC	4.5
Inlet closes ABDC	35.5
Exhaust opens BBDC	35.5
Exhaust closes ATDC	4.5
Lub. Oil pump delivery	6.50 lit/min.
Sump capacity	2.70 litre
Lub. Oil consumption	1.5% normally exceed of fuel
Connecting rod length	234

RESULT & DISCUSSION

- **Brake Thermal Efficiency**

Figure represents the variation of brake thermal efficiency of diesel at different load on low, medium & high injection pressure of the engine running at normal & supercharging condition for different fuel. Brake thermal efficiency is defined as the ratio of brake power to product of fuel consumption and calorific value. Above graph shows that the brake thermal efficiency increased with increased in the load. From figure concluded that the Brake thermal efficiency of diesel is same for low, medium & high injection pressure.



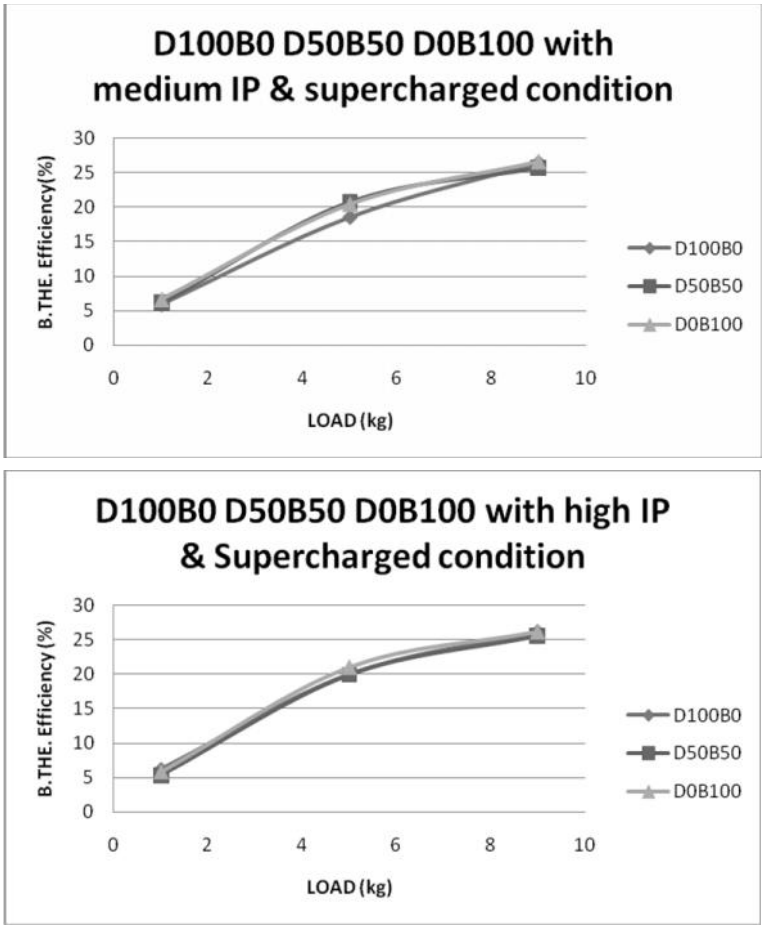


Figure 3: Variation of brake thermal efficiency with respect to load at supercharging condition

- **Brake Specific Fuel Consumption:**

The above represents the variation of brake specific fuel consumption of diesel at different load on low, medium & high injection pressure of the engine running at normal & supercharging condition for different fuel. The specific fuel consumption depends upon the engine power. The specific fuel consumption decreases with increase in load. From figure concluded that the Brake specific fuel consumption of diesel is same for low, medium & high injection pressure.

- **Injection Pressure**

Injection pressure is a pressure which is required to inject the fuel into cylinder. For smooth function of injector, it is required that the injection pressure is higher than cylinder pressure. Higher the injection pressure gives better the dispersion and penetration of the fuel into all desired locations in combustion chamber. As the piston moves approximately two-thirds of the way up in the cylinder on the compression stroke, the injector cam lobe begins to

lift causing the injector rocker arm to push down on the follower and the plunger. Plunger return spring bring back to initial position.

- **How to Vary the Injection Pressure?**

On the upper part of plunger the adjustable screw is attached to the injector. By varying the position of plunger, change in the injection pressure is achieved. It is required to calibrate the screw or injector.

- **Effect of Injection Pressure**

As with increasing fuel injection pressure can, at least up to some point, result in superior mixing of the fuel with the intake gas, ordinarily resulting in more complete combustion and thus more NOx, less particulate Metter and HC emission and greater cylinder pressure, fuel economy and power.

- **Inlet Air Pressure**

Inlet air pressure is a pressure of air when it is enter into cylinder at the time of suction stroke. Increase in intake pressure or supercharging reduces the auto-ignition temperature and hence reduces delay period. Since the compression pressure will increase with intake pressure, the peak pressure will be higher. Also the power output will be more as cylinder will contain more air and hence more fuel can be injected per stroke.

- **How to Vary Inlet Air Pressure?**

Change in inlet air pressure is done by air compressor as external devices which convey air to the cylinder. Throughout the engine running constant supply of air is done by air compressor.

- **Engine Load**

As engine speed increases, the loss of heat during compression decreases with the results that both temperature and pressure of the compressed air tends to rise, thus the increase in turbulence, however may tend to increase the heat loss in some cases.

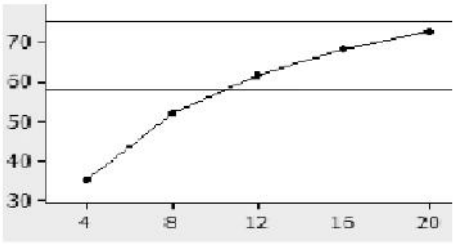


Figure 4: Effect of Engine Load on Mechanical Efficiency

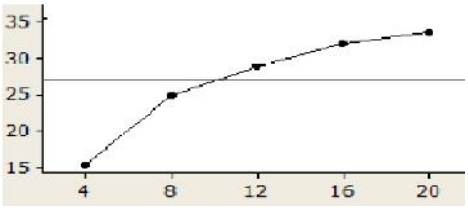


Figure 5: Effect of Engine Load on and Brake Thermal Efficiency

From above figure, when load increases brake thermal efficiency and mechanical efficiency also increase in proportion.

- **How to vary Engine load?**

Rock brake dynamometer is used for change the load on machine. When we rotate the wheel above rope brake drum, it may lose or tight drum. Consequently, friction between drum and belt will be increased or decreased. So that load will be increased or decreased.

- **Experiment Parameter**

Table 2: Experimental Parameters

Blend Ratio	D100B0, D50B50, D0B100
Injection Pressure	Low, Medium, High
Engine Load	1, 5, 9
Compression Ratio	18

  - The measuring parameter are Brake Power, Specific Fuel Consumption, Brake Thermal Efficiency, Fuel Consumption, and Mechanical Efficiency.
  - Also find out emission parameter like CO, CO2, NOx, and HC.

- **Observation Table**
  - **Normal Condition**

In its first condition engine take atmospheric air as an inlet air.

Table 3: Engine Runs on these Values at Normal Condition

Blend Ratio	Injection Pressure	Load
0	L	1,5,9
0	M	1,5,9
0	H	1,5,9
50	L	1,5,9
50	M	1,5,9
50	H	1,5,9
100	L	1,5,9
100	M	1,5,9
100	H	1,5,9

  - **Supercharging (with compressor)**

In it engine take continuous flow of air with the use of air compressor as an external device.

Table 5: Engine Runs On These Values At Supercharge Condition

Blend Ratio	Injection Pressure	Load
0	L	1,5,9
0	M	1,5,9
0	H	1,5,9
50	L	1,5,9
50	M	1,5,9
50	H	1,5,9
100	L	1,5,9
100	M	1,5,9
100	H	1,5,9

After performing the experiment the results were obtained and those results were shown in the graphical form for better understanding and getting the conclusion in more precise level. The Conclusion which can be making out from the experiments is as listed below. The fuel consumption of all blends is slightly more than the diesel at all different loads. But D50B50.

- Karanja biodiesel blend have considerable lesser fuel consumption at low & medium injection pressure than all the different blends and diesel at engine supercharging conditions.
- We get most favourable specific fuel consumption for D0B100 when engine run at supercharged condition compared to diesel, which is nearest to the diesel fuel.
- We get the best possible Brake thermal efficiency of D0B100 Karanja biodiesel blend is among all other blends at various loads which is slightly greater than the diesel fuel.
- The mechanical efficiency of all blends are less than diesel fuel. We analyze that the D50B50 blend have highest mechanical efficiency at supercharging condition is 41.43 % at low injection pressure at higher load than all different blends as well as diesel.
- The uses of biodiesel blends are inversely proportional to torque and brake thermal efficiency, when we use of Karanja biodiesel in a conventional diesel engine.
- With supercharging condition Jatropha biodiesel & its blend with diesel have considerable lesser Emission of HC, CO, CO2, NOX as compared to diesel.
- D0B100 Jatropha blend have least CO emission at different loading condition than the all other blend and diesel at the engine supercharging condition.
- D0B100 blend have lowest carbon dioxide emission than all other blend and diesel at all loads at engine normal condition. With the supercharging effect CO2 emission is increased with use of all Karanja blend.
- Nitrogen oxide Emission for D0B100 Karanja biodiesel has lowest NOX emission at all varying loads of engine normal condition. With the supercharging effect NOx emission is increased with use of all Karanja blend than diesel fuel.
- D0B100 can be accepted as a appropriate fuel for use in standard diesel engines and advance studies can be done with definite additives to improve the emission features.
- Cylinder pressure of Karanja blend decreased with the use of supercharging condition of engine compared to diesel. Also the start of combustion shifts towards left compared to pure diesel of engine normal condition.
- At all engine loads combustion starts earlier for biodiesel than for diesel. Because of early combustion a short ignition delay and advanced injection timing for biodiesel
- Cylinder peak pressure of D0B100 is higher in all load condition for both engine normal & supercharging condition. Cylinder peak pressure of D50B50 is lower than D0B100 fuel. If blend ratio is decreased than cylinder peak pressure is also decrease for engine both normal & supercharging condition.

SCOPE OF FUTURE WORK

This experimental work has following types of scope for doing further future work.

- In India Karanja biodiesel have a wide scope, Karanja biodiesel can be used directly as a working fluid in diesel engine.
- It can be checked for better performance of diesel engine with or without changing the other performance parameters of engine.
- Extensive study on EGR with this experiment can be performed.
- By changing constraint and various blend proportions it can be used for finding preeminent optimized result by using Karanja biodiesel-diesel blend in CI engine.
- We can check at the different ratios of blends using alternative fuel with diesel can also be useful in CI engine for finding out the optimized results.
- Some additives can also be used for much improved performance characteristics with this blend.

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