Study of CI engine performance characteristics by using hibiscus cannabinus biodiesel and its blends

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Abstract: The quickly weariness of petroleum products because of the taking off industrialization and vehicles of the world. The excursion for elective fills has had the option to be unavoidable, looking energy of diesel for transportation portion. Biodiesel has transformed into a key source as usage powers for CI engines. Biodiesel gotten from vegetable oils are totally promising alternative fills for diesel engine. The delivered of Hibiscus Cannabinus biodiesel is blended in with diesel fuel like (Hibiscus Cannabinus biodiesel H100%H80%H60%H40%,andH20%). The ignition, execution and outflow qualities will be assessed at variable burdens and consistent evaluated speed 1500rpm, modified weight extent 16.5:1, fixed weight 200 bar and result will be contrasted and diesel fuel.

1. Introduction

Hibiscus cannabinus has a spot with the family Malvaceae. It had moreover been known as bimili, Ambadi hemp, and a multipurpose tree that can grow well under a wide extent of threatening natural condition. Its origin is nearby to Southern Asia, by and by found in different regions of India. It is a yearly or biennial herbaceous plant generally accomplishes a height about 1.5-3.5m and stems estimation approximately 1-2 cm and it is every so often passing plant. It is adaptable to a wide extent of environment and soil. It is as often as possible recommended for tropical and sub tropical environments and twists best with temperatures of 15-27°C during the creating season. Ambadi is a flexible variety of soils, best being a significant, freezable, well drained, sandy loam with humus. A pH of fair-minded to some degree destructive is suggested.

2. Literature review

2.1. G. Venkata Subbaiah, Durga Prasad & K. Tirupathi Reddy.

They carry out an experiment with all the fuel modes on the diesel engine. Initial with the pure diesel and the diesel fuel was substituted with pure biodiesel of rice bran (B100) and experiment was performed by changeable the variation loads in the similar manner. Biodiesel, the same test was conducted with the blend of D90%B10%. Three biodiesel-ethanol and diesel mixes were performed such as D85%, B10% and 5% bioethanol (B10E5), D80%, B10% and 10% bioethanol (B10E10), and (B10E15) and bring into being that the utmost BTE observed with B10%,E15% was more than that of D100%.B100% and at maximum load of the engine, The BSFC bigger with the blends B10%,E5%, B10%E10% and B10%E15 %estimated with the blend B10%. The NOx emissions of bio-diesel, blend of B10% and biodiesel-ethanol blends were not as much of at low loads.
2.2. Dr. O. D. Hebbal

Studied performance characteristics of a diesel with Deccan hemp biodiesel. It is preferred for an experiment on a CI engine and its fitness as an interchange fuel is performed. The viscosity of biodiesel is reduced initially by blends with diesel in B25%-D75%, B50-D50%, B75%-D25%, B100%-D0% based on volume, then investigated and evaluated with diesel. The thermal efficiency, BSFC, BSEC is well similar with pure diesel and emissions are slight more for B25% and B50% mixes. From experiment it has been well-known that up to B25% of blend of biodiesel without heating and up to B50% mix and with pre-heating can be replaced with for CI engine.

2.3. M. C. Navandgi

Study of the appropriateness of cottonseed biodiesel and castor oil as alternate fuel for CI engines. Single cylinder and four stroke diesel engine performance is calculated with castor oil and cottonseed oil. Castor oil and cottonseed oil are transformed to their respective biodiesel form by transesterification process and then, they are experienced with different blends over variation engine loads. Transesterification demonstrate improvement in chemical and physical properties. Biodiesel have approximately all properties similar to diesel and viscosity is slightly more than diesel fuel.

3. Materials and Methods

Table 1. Properties of Pure diesel and Hibiscus cannabinus biodiesel.

| Properties                        | Diesel     | Hibiscus cannabinus |
|-----------------------------------|------------|----------------------|
| Density at 300 c in Gm/cc         | 0.83       | 0.87                 |
| Calorific Value (kj/kg)           | 42500      | 39488                |
| Kinematic Viscosity (cSt)         | 2.1        | 4.6                  |
| Flash point in (0 c)              | 55         | 153                  |
| Fire point in (0 c)               | 66         | 171                  |

3.1. Density

Figure 1. Density of bio-diesel with different blends
3.2. Calorific value

![Calorific value of bio-diesel with different blends](image)

**Figure 2.** Calorific value of bio-diesel with different blends

4. Experimental setup

The experimental is consists of four strokes, single cylinder water cooled connected with eddy current dynamometer for variable loading.

![Experimental setup](image)

**Figure 3.** Experimental setup
Fig.4.1 Line diagram of Experimental setup

| Table-2 Engine Specification | Table-3 Notations |
|-----------------------------|-------------------|
| **Manufacturer** | Kirloskar oil engines |
| Ltd, India |  |
| **Model** | TV-SR, naturally  |
| **aspirated** |  |
| **Engine** | Single cylinder, DI |
| **Bore/stroke** | 87.5mm/110mm |
| **C.R.** | 16.5:1 |
| **speed** | 1500r/min, constant |
| **Rated power** | 5.2kw |
| **Working cycle** | four stroke |
| **Injection pressure** | 200bar/23 def TDC |
| **Type of sensor** | Piezo electric |
| **Response time** | 4 micro seconds |
| **Crank angle sensor** | 1-degree crank angle |
| **Resolution of 1 deg** | 360 deg with a |
| **resolution of 1deg** |  |

| **PT** | Pressure transducer |
| **N** | Rotary encoder |
| **Wt** | Weight |
| **F1** | Fuel flow |
| **F2** | Air flow |
| **F3** | Jacket water flow |
| **F4** | Calorimeter water flow |
| **T1** | Jacket water inlet temperature |
| **T2** | Jacket water outlet temperature |
| **T3** | Calorimeter water inlet temperature = T1 |
| **T4** | Calorimeter water outlet temperature |
| **T5** | Exhaust gas to calorimeter temperature |
| **T6** | Exhaust gas from calorimeter temperature |
5. Results and discussion

5.1. Indicated Power (IP)

Figure 4. Indicated Power versus Brake Power

Figure 4. Shows the comparison of IP with BP for different biodiesel blend. The IP for B100%D0% is closer neat diesel at low load and slightly more than pure diesel at maximum load.

5.2. Brake Mean Effective Pressure

Figure 5. BMEP versus BP

Various blends with diesel and biodiesel gives close BMEP as shown in figure 5.
5.3. Indicate Mean Effective Pressure (IMEP)

![Graph showing IMEP vs Load Brake Power](image)

**Figure 6.** Indicate Mean Effective Pressure versus Load Brake Power
Comparison of pure biodiesel with diesel which gives IMEP very near at low load, changes slightly with increases load on engine.

5.4. Brake Thermal Efficiency

![Graph showing BTE vs Brake Power](image)

**Figure 7.** Brake thermal efficiency versus Brake Power
H20% and H40% have more BTE as compare to diesel, shows from Figure 7.
5.5. *Indicated Thermal efficiency*

![Figure 8. ITE versus BP](image)

The various biodiesel with diesel blends as shown in graph it is observed from the graph D40% and B60% which gives close ITE.

5.6. *Mechanical Efficiency*

![Figure 9. Mechanical efficiency versus BP](image)

Mechanical efficiency of D100% is close with all blends biodiesel and D80% which gives increases with mechanical efficiency as shown in figure 9.
5.8. BMEP

![BMEP versus BP graph]

**Figure 10.** BMEP versus BP

It is seen from the graph at lesser load of all mixes BMEP are nearer to diesel and more load all mixes BMEP values are high.

5.9. Specific Fuel Consumption load

![Specific Fuel Consumption versus Brake Power graph]

**Figure 11.** Specific Fuel Consumption versus Brake Power

It is seen from the graph the SFC for biodiesel and their mixes are more than diesel. H20% and H40% mixes are near of CI engine at more loads.
5.10. **Volumetric Efficiency**

![Figure 12. Volumetric Efficiency versus Brake Power](image)

The D100% of volumetric efficiency is more than all blends of biodiesel and biodiesel ratio increases with diesel volumetric efficiency decreases as shown in graph.

5.11. **Air fuel Ratio**

![Figure 13. Air fuel Ratio versus Brake Power](image)

Figure 12. Shows the correlation of AFR with BP for various biodiesel blends. It is seen from the diagram that H20%, H40%, and H60% have more AFR than diesel and H100% is nearer to diesel.
6. Conclusion

Hibiscus cannabinus biodiesel oil was effectively operated diesel engine (CI) with different blends.

1. Hibiscus cannabinus biodiesel perform the essential properties of diesel.
2. Hibiscus cannabinus biodiesel thermal efficiency D60%H40% and D80%H20% more than diesel.
3. Hibiscus cannabinus biodiesel of the SFC for various mixes is higher at several rate D80%H20% is nearer to diesel.
4. Hibiscus cannabinus biodiesel Air fuel ratio is more than of diesel.
5. Cylinder pressure of Hibiscus cannabinus biodiesel is more than diesel fuel.
6. Various blends with diesel and biodiesel gives close BMEP.
7. Comparison of pure biodiesel with diesel which gives IMEP very near at low load, changes slightly with increases load on engine.
8. H20%D80% and H40%D60% have more BTE as compare to diesel.
9. Mechanical efficiency of D100% is close with all blends biodiesel and D80% which gives increases with mechanical efficiency.
10. Variation in brake specific fuel consumption with changeable load and varying mix. From the curve of B20%, and B40% and B100% biodiesel, it is experimental that the curves are almost close to each other.

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