Retraction

Retraction: An Effect of Engine Performance and Exhaust Emissions using Palma Rosa grass oil as Biodiesel (IOP Conf. Ser.: Mater. Sci. Eng. 1145 012075)

Published 23 February 2022

This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

Retraction published: 23 February 2022
An Effect of Engine Performance and Exhaust Emissions using Palma Rosa grass oil as Biodiesel

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Abstract. In the current scenario, all the developing countries majorly depend on the Transportation sector for this they need a high volume of fuel resources this made the developing countries bargain from the oil-producing countries. Due to the high demand for fuel, price hike which brings a burden to the people, emission of CO2 leads to the pollution which in turn causing damage to the Atmosphere. To reduce the pollution and price hike we need an alternate solution like Biodiesel for this the biodiesel from palmarosa grass oil can be used as fuel at the different blends, the properties of the fuel, Performance, Emission, brake thermal efficiency, Specific fuel consumption are analysed at the different blends of Diesel and Biodiesel at the four-stroke diesel engine at different load condition and various mixtures of biofuel (P10, P20, P30). The result of the experiment shows that biodiesel blends P30 gives the maximum brake thermal efficiency of 35.18% which is comparatively lower than diesel. Thus, the biodiesel blend of P30 has a reduction in the emission of CO2 and HC at the level of 5% and 4%, where carbon monoxide emission is slightly reduced compared to diesel.

Keywords: Biodiesel, Transesterification, palmarosa, Performance and emission

1. Introduction

Biodiesel production and usage are increasing drastically nowadays due to its good natural properties. Because of high emission and a hike in the cost of diesel and other petroleum products, the need for alternate fuel like biodiesel is required to full fill the need of normal people. Biodiesel is a form of non-renewable fuel that can only be extracted from animal fat or glyceride contained oils. It is mainly used in the self-ignition engine (diesel or CI engine). It has Sulphur-free properties and other harmful properties. Biodiesel is produced from Transesterification (a chemical method) followed by a Bubbling process (a separation method) by this catalyst, biodiesel gets separated and further catalyst can be used again in the Transesterification process. Biodiesel is extracted from sunflower oil[1], frying palm oil[1-8], olive oil[4-5], Castro oil[2], coriander oil[3], Lemon grass oil[7]. The oil that contains FFA (free fatty acid) level greater than one can only convert into Biofuel. Less emission of CO and NOx is one of the key features of Biodiesel when compare to other petroleum products. To satisfy all requirements to be a Biodiesel, oil extracted from Palmarosa grass can be the best option for the Biodiesel extraction because of its high FFA content and it can be available on a large scale at low cost. Palmarosa oil and its by-products in diesel engine

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leads to fundamental rejection in emissions of Sulphur dioxide, carbon monoxide (CO) and noise [2]. The different ratio mixture of Diesel and palmarosa grass oil (P10, P20, P30) made and tested for properties and the compare the engine Performance and emission value with the normal diesel to find the best bend ratio.

2. Materials and Methodology

2.1. Preparation of Oil

Palmarosa belongs to the lemongrass family, palmarosa grass oil is extracted by steam distillation method of dried grass which is harvested before flowering this palmarosa is smells like a rose this is the reason why it got its name palmarosa. First, the grass is harvested and allows wilting for up to 24 hrs. then the grass is chopped into shorter length for better usage, the grass is arranged firmly packed as it prevents the formation of a steam channel. The steam is boiled in the still at the pressure from 18 to 32 kg, and after some time, the mixture of palmarosa oil along with the water vapour is allowed to pass through the condenser, and as we know the oil is lighter than water and insoluble floats on top and drawn off continuously, then the oil is collected and filtered

2.2 Trans-esterification

Transesterification is the chemical process that involves the reaction of fat or oil with the alcohol to form ester and glycerol in the presence of catalyst, catalyst is used to faster the reaction rate and yield [9]. Ethanol and methanol are mainly used alcohol because of their low cost and availability [10]. This process makes the oil to be thinner which can be used in the engine, and also the process involves the production of ester at each reaction from the oil by making the triglyceride to diglycerides and further into monoglyceride, and at last glycerides are transformed into glycerol. Figure 1 shows the Transesterification of palmarosa grass oil

The reaction involved in the Transesterification process is shown below

1. Alcohol + ester → different alcohol + different ester
2. Triglyceride + methanol → glycerol + mixture of fatty ester

![Figure 1. Transesterification of palmarosa grass oil](image-url)
In this study properties of palmarosa oil were determined, availability of palmarosa oil is around 30MT per year and most of the oil is not as much utilized due to the unawareness of the natural properties of the oil, properties like density, flash point, fire point, Kinematic viscosity, cetane index, calorific value and other properties like appearance, water content, ash of the oil were set on. The properties comparison of Diesel and palmarosa oil is shown below in table 1. Other properties of Palmarosa oil are shown in Table 2.

### Table 1. Chemical properties of Diesel and Biodiesel (Palmarosa oil)

| Fuel properties                  | Biodiesel | Diesel |
|----------------------------------|-----------|--------|
| Density @ 15°C kg/m              | 928.2     | 850    |
| Flashpoint                       | 228°C     | 68°C   |
| Fire point                       | 240°C     | 210°C  |
| Kinematic viscosity @40°C cst    | 33.89     | 2.51   |
| Cetane index                     | 40        | 47-53  |
| Calorific value kJ/kg            | 36672     | 42927  |

### Table 2. Other properties of Palmarosa oil

| Properties                      | Result               |
|---------------------------------|----------------------|
| Appearance                      | Dark brownish yellow oil |
| Water-content                   | 0.12%                |
| Ash                             | 0.005%               |
| Iodine value (Wij)              | 104.1                |
| Sulphur content                 | 0.09%                |

### 3. Test Specification and Test Procedure

Experimental testing is going to be carried out on the four-stroke single-cylinder VCR water-cooled diesel engine; testing engine specification is shown below in Table 3.

### Table 3. Testing Engine Specification

| Parts & parameter | Type / Size |
|-------------------|-------------|
| Make              | Kirloskar   |
| Number of cylinders | 1         |
To achieve the steady-state condition the engine has to run for 10-15 minutes without any loading condition, after attaining the steady-state condition the probe was inserted in the exhaust port, to warm up the engine diesel is used and the oil maintains at the temperature of around 85°C.

The Speed of the engine is maintained constant of 1500 rpm at the given load condition, Then the diesel is replaced with the Biodiesel blend of P10, P20, P30 and the Performance of the engine at different biodiesel blends are calculated using an Electronic Data Acquisition at varying load condition, Testing VCR diesel engine is shown in figure 2 below.

![Single Cylinder Four-stroke VCR Diesel Engine Experimental setup](image)

**Figure 2. Single Cylinder Four-stroke VCR Diesel Engine Experimental setup**

### 3.1 Test outcome

#### 3.1.1 Brake Thermal Efficiency

Brake Thermal Efficiency is defined as the ratio of brake power to Fuel power (calorific value x mass of fuel consumed). It is used to analyse how well an engine converts the heat from a fuel to mechanical energy, the result can be viewed in the form of a graph.

#### 3.1.2 Specific Fuel Consumption

Specific Fuel Consumption of an engine may be defined as the quantity of fuel required to do a certain level of work, is also seen in the form of a graph for easy understanding.
3.1.3 Emission. An emission test is carried to find out the level of air pollutants emitted to the atmosphere at the different load condition of the engine, the main emission characteristics are CO2, CO, NO, HC and emission from evaporation.

3.1.4 Performance. The performance of the engine is analysed to evaluate the best engine output at the different load condition and for different blends of Fuel.

4. Result and Discussion

4.1. Performance parameter
IC Engine set up under test is Research Diesel engine having power 3.50 kW @ 1500 rpm which is 1 Cylinder, four-stroke, Constant Speed, Water Cooled, Diesel Engine, with Cylinder Bore 87.50mm, Stroke Length 110mm, Connecting Rod length 234mm, Compression Ratio 17.50, Swept volume 661.45 cc, testing has done for the various mechanical parameter like Brake thermal efficiency, mechanical efficiency, specific fuel consumption, and emission. And below, all the mechanical parameter of all three blends is compared with the mechanical parameter of Diesel in the form of a line graph and it explained in detail. From the below graph Figure 3 show the brake thermal efficiency. Of the blend, P30 (30% palmarosa oil & 70% diesel) at the load of 9 kg at the speed of 1500 rpm gives the higher efficiency of 30.1 when compared to normal diesel with the brake thermal efficiency of 26% and also higher than the other blends at the load of 9 kg and the speed of 1500 rpm.

![Figure 3. Brake thermal efficiency of Biodiesel blends at different loading condition](image)

Figure 4 shows the mechanical efficiency of the biodiesel blends and diesel at the varying load condition. First, the efficiency of the diesel and other blend is increased gradually after applying the load, the heat released during the process makes the increase in the indicated power, and the maximum mechanical efficiency can be achieved by the blend P30 (30 % palmarosa mixed with 70 % diesel) at the load 9 kg at speed of 1500 rpm has 35.18% which is slightly higher than the Diesel of 35% and the other blends at the same loading and same speed condition.
4.2. Emission parameter
The blends of biodiesel are tested for the emission parameters to check the level of NOx, carbon-di-oxide, carbon monoxide and HC using the gas analyser. And the emission parameters of biodiesel are plotted in the form of a line graph and the less emission biodiesel blend is determined [6]. Figure 6 shows the CO emission of the biodiesel blends at the different loading condition, the CO emission can be minimised by supplying high amount oxygen into the engine, in the graph it shows that the emission of blends of palmarosa grass oil will not make any much difference in the CO emission when compared to diesel, but the blend of P10 has the maximum of reduction at the 9 kg loading condition compared to other biodiesels [7-8].
Figure 7 shows the emission HC of different biodiesel blend in ppm, and this investigation shows that the biodiesel blend of P20 (20% palmarosa mixed with 80% diesel) has 26 ppm which is comparatively minimum than the other biodiesel blend and diesel, and the P20 oil has the constant emission in the different loading condition compare to other oil ratios.

![Figure 7. HC emission of Biodiesel blends at different loading condition](image)

Emission of NOx of different blends of biodiesel is plotted in the line graph shown in Figure 8, the test shows that the biodiesel mixture of P30 (30% palmarosa oil & 70% diesel) has the lower NOx emission of 134 ppm at the maximum loading condition of 9 kg when compared to the normal diesel at the same condition it is 36 times lesser, the ignition delay caused by the lower cetane number of oils had made the higher emission of other biodiesel oil.

![Figure 8. NOx emission of biodiesel blends at different loading condition](image)

The Main pollution causing factor to the environment is CO₂, and below graph figure 9 shows values of emission of CO₂ in different biodiesel blends are plotted and analysed, it shows that overall emission of CO₂ is reduced due to the high supply of oxygen into the engine, and comparing the CO₂ emission with the other oils, biodiesel blend of P30 has the minimum emission of CO₂ at the 9 kg load condition and speed of 1500 rpm.

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5. Cost Analyses

One of main parameter to choose the oil is the low-Cost fuel, in order to find the minimum cost fuel, the cost analysis is one for the various blends of diesel and compared with normal diesel, below Table 4 shows the cost analyses of diesel and biodiesel comparison.

|          | P10 | P20 | P30 |
|----------|-----|-----|-----|
| Diesel (Rs.) | 81  | 72  | 63  |
| Palma Rosa oil (Rs.) | 5   | 10  | 15  |
| Total (Rs.)        | 86  | 82  | 78  |

From the table we understand that cost comparison of three blends and diesel, shows that the blends of P30(30% palmarosa grass oil & 70% diesel) have the minimum cost value of Rs. 78 (including all post process) when compare with normal diesel value (Rs. 90).

6. Conclusion

A brief investigation of a Single-cylinder Four-stroke diesel engine with the different blends of biodiesel i.e., palmarosa grass oil with diesel is tested the different loading condition of 0kg, 3kg, 6kg, 9kg at the speed of 1500 rpm was done in the current study and the following result were obtained:

- Mechanical efficiency ($\eta_{Me}$) and Brake Thermal efficiency ($\eta_{Bt}$) is slightly increased by 15% of the P30 (30% of palmarosa biodiesel mixed with 70% of diesel), and this is mainly due to fuel properties like lower density, lower viscosity, the higher calorific value of palmarosa grass oil.
- Specific fuel consumption (SFC) of the Biodiesel blend decreases gradually with an increase in varying load condition when analysed with normal diesel. Specific fuel consumption is almost equal for all blends and diesel at the 9kg load condition, reduction in specific fuel consumption is because of faster combustion and evaporation of palmarosa grass oil particles than diesel.
- There is no noticeable variation in the emission, but compare to diesel, P30(30% palmarosa oil mixed with 70% diesel) has a significant reduction in the NOx by 134 ppm, HC by 26 ppm, compared to diesel the incomplete combustion is comparatively less.
- CO is reduced by a minimum different compare to diesel.
Cost analyses of Biodiesel blends and diesel, shows P30 palmarosa grass oil blend has total cost value of Rs.78, which is comparatively lower than normal diesel value (Rs. 90).

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