Retraction

Retraction: An Engine performance analysis and emission characteristics of IC engine using mixture of canola and pongamia oil as biodiesel (IOP Conf. Ser.: Mater. Sci. Eng. 1145 012097)

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This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines.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

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An Engine performance analysis and emission characteristics of IC engine using mixture of canola and pongamia oil as biodiesel.

K Mohan¹, R Sharfaraaz Ismail¹, S Rudresh¹, K S Sanjayram¹ and A Vinodh Kumar¹

¹Department of Mechanical Engineering, Sri Krishna College of Technology, Kovai pudur, Coimbatore, Tamil Nadu
mohan.k@skct.edu.in¹

Abstract. In India ranks 6th in Diesel consumption, 3.5% total commercial power. Current usage of diesel in India is about 88.8 billion liter (70% of total petrol production consumption) and is expected to reach 130 billion liter in 2025 as demand is growing at a rate of 5.6% per annum. While at home crude oil and natural gas production will remain around 33.97 mt during 2006-07. So, there will be a huge gap between demand as well as supply that needs to be met with increased fuel intake or increasing biodiesel production by improving biodiesel fields without sacrificing world food security. Biodiesel is a renewable energy source created for renewable energy waste and degraded areas. Biofuel is a fuel that contains high-fat mono-alkyl esters acids of vegetable oil or animal fats, found in plants or animal. Consumption of biofuel requires very little modification or not of the engine when combined with diesel up to 20% (B20). Biofuel consumption results in a significant reduction in non-combustible hydrocarbons by 30%, carbon monoxide by 20% and compound by 25%. It has almost there is no sulfur. Other than that, it has about 10% of the built-in oxygen, i.e., helps with fire burning and several positive Cetane. So, we have proposed Bio diesel production from Canola oil and Pongamia oil, we have used acid catalyst and methanal to produce Bio diesel. Green seed canola oil and Pongamia oil is Low grade oil. In this research, biodiesel was produced from canola oil, Pongamia oil, Transesterification of both oil with Alcohol, and Methanal catalyst (Canola) H₂SO₄ Acid catalyst (Pongamia oil). The reaction was conducted at Room Temperature and a stirring speed of 50 Rpm for 10 min. Prior to transesterification, green seed canola oil was bleached to remove pigments using various adsorbents at different conditions. We have tested various blend of Biodiesel named as B10, B20, and B30 in Single Cylinder Four-stroke VCR Diesel Engine. The Break thermal efficiency and Mechanical Efficiency was increased 15% and fuel consumption and cost was reduced.

Keywords: Biofuel, Pongamia oil, canola oil, acid catalyst

1. Introduction

In the search for new energy sources, much attention is given focused on biomass as a reliable and renewable source namely able to satisfy an important part of energy needs. Currently, biodiesel is considered a real alternative to diesel fuel because of its subsequent benefits.

1. It can reduce dependence on external crude oil absorbs and enhances energy security.
2. It has positive the return of energy to invested energy.
3. It can slow down greenhouse gas emissions and low-risk emissions.
4. It is biodegradable, nontoxic, and renewable
5. It can help to improve rural areas the economy since the rest is used as raw material property.
Although biodiesel is also possible legally it is naturally acceptable, it should be noted that it is not economic competition[1].

High cost of used vegetables oil is a very important issue in economic analysis of biodiesel process. Reducing feed costs is required for long-term commercial biodiesel production.

To achieve a reduction in production and manufacturing costs biodiesel is very competitive with diesel, low cost feedstocks, such as canola oil and pongamia oil can be used as raw material.

However, since 2002, the European Union (EU) enforce a ban on feeding these compounds to animals in order to prevent the return of harmful chemicals back into the diet press the meat of the animal. In fact, most of the use cooking oil is poured into the sewage system in the cities. This will contribute to the pollution of rivers, lakes, and seas groundwater, leading to adverse effects on the environment and human health.[2]

Therefore, the disposal of in safe oil waste is it is necessary because it may be contaminated nature. Consumption of waste oil in production biodiesel is one of the most efficient and cost-effective methods to solve this [3]. Extensive research has been done to investigate biodiesel production in fatty acids under acid, alkaline(H2SO4) and ethanol catalysis. Canola oil show structures that are different from those that have been refined fat. High temperature for certain cooking processes and water from food accelerates the hydrolysis of triglycerides and increase FFA content in fats. Acid catalysis is effective when the amount of FFA in oil exceeds 1%, the kinetics of acid catalyzed transesterification of excessive waste oil methanol to produce biodiesel. They conclude that it is pseudo-first-order reaction, as long as methanol / oil molar ratio is close to 250: 1 at 70 ºc or at 74: 1- 250: 1 to 80 ºc. Under these circumstances, the high yield of biodiesel (99 ± 1%) can be obtained at a stimulant dose of 400 rpm, using feed molar ratio oil: methanol: acid 1: 245: 3.8. Although acid-catalyzed transesterification is not resistant to FFA in feedstock, requires longer response time as well high temperature [4-9]. Many researchers recommend using it

Acid-catalysis as a pre-treatment step followed by an alkaline catalyzed step. adopted this two-step process recycling process to prepare biodiesel from waste recipes oil.

In the first step, FFA oil for cooking oil was available proven methanol made with ferric sulfate. In the program Second, the triglycerides in contaminated canola oil were the same trans esterified with methanol (methanol / molar oil ratio = 6) promoted by 1.0 wt% potassium hydroxide at 65 ºc per an hour.

After this two-step process of catalysis, the final product with biodiesel conversion by 97.02%. One different response conditions suitable for pilot-scale as well industrial biodiesel production targets have been achieved be: Oil / alcohol molar ratio, 1: 6; temperature, 55 ± 1 ºc; naoh value, 1% (by weight of fat); dynamic speed, 40 per minute; pressure, atmosphere; response time, 60 min. This paper focuses on testing the feasibility using recycled canola oil as a raw material for biodiesel synthesis through a two-step reaction. Definition the biodiesel results produced in this process have shown that can meet the requirements of ASTM D 6751, which guarantees the possibility of using recycled canola oil as raw material to make produce standard ASTM fuel[10]. In the meantime, properties of crude glycerol, such as flash point, moisture, the ash, and the glycerol content, was also evident, which will benefit from further biorefinery research further.

2. Materials and methodology

A. Canola oil:

The word rape comes from the Latin word rapum meaning turnip. Turnip, rutabaga (swede), cabbage, Brussels sprouts, and mustard related to rape.

Rapeseed belongs to the Brassica genus. Oil-bearing Brassica varieties are some of the oldest man-made plants, with their use in India 4,000 years ago, and used in China and Japan 2,000 years ago. 55 Its use in Northern Europe with oil lamps is dated to the 13th century. Rapid fuel extraction was first
introduced to the market in 1956 to 1957 as a food product, but this met with some unacceptable features. The reconstituted oil had a distinct taste and discolored green color, due to the presence of chlorophyll. It also contains very high erucic acid[11-13]. Genetically modified canola attracts a fine price compared to non-GM canola; in Western Australia, an estimated 7.2% on average. Figure 1 shows Canola Oil

![Canola Oil](image1)

**Figure 1. Canola Oil**

B. *Pongamia Oil*

Pongamia oil is extracted from the seeds of the millet tree of *Millettia pinnata*, native to tropical Asia. *Millettia pinnata*, also known as *Pongamia pinnata* or *Pongamia glabra*, is common throughout Asia and therefore has many different names in different languages, many of which are used in English to describe seed oil extracted from *M. pinnata*. *Pongamia* is commonly used as a generic name of the tree and is derived from the type of tree that was originally planted. Some of its oil names include honge oil, kanuga oil, karanja oil, and pungai designations. Figure 2 shows the Pongamia oil

![Pongamia oil](image2)

**Figure 2. Pongamia oil**

C. *Alcohol*

In chemistry, alcohol is a compound that contains at least one hydroxyl group (functional OH) bound to a complete carbon atom [14]. The term alcohol originally referred to ethyl alcohol (ethyl alcohol), which is used as a drug and is a major alcoholic beverage.

D. *Sulfuric Acid (H₂SO₄)*

Sulfuric acid (American spelling / IUPAC) or sulfuric acid (traditional / British spelling), also known as vitriol oil, is a mineral acid composed of sulfur, oxygen and hydrogen, with the molecular formula H₂SO₄. It is a colorless and viscous liquid mixed with water in all concentrations.

E. *Methanal*
Methanbal is a naturally occurring compound with the formula CH₂O. The pure compound is a color gas that smells and produces an automatic form of paraformaldehyde, which is why it is kept as an aqueous solution. It is the simplest of aldehydes.

F. Preparation of canola oil
Canola oil is extracted by heating a small amount of crushed canola seeds dissolved in hexane solvent or in a cold paste. Finally, it is filtered using a shower of water and organic acid to remove gums and free fatty acids, filter to remove color, and remove odor using a scented drink.

G. Preparation of Pongamia oil
Pongamia oil is extracted from the seeds of the millet tree of Millettia pinnata, native to tropical Asia. Millettia pinnata, also known as Pongamia pinnata or Pongamia glabra, is common throughout Asia and therefore has many different names in different languages, many of which are used in English to describe seed oil extracted from Mn. Pinnata; Pongamia is commonly used as a generic name of the tree and is derived from the type of tree that was originally planted. Some of its oil names include honge oil, kanuga oil, karanja oil, and punjai.

H. Properties of Alcohol
Boiling points of alcohol are much higher than those of alkanes with the same molecular weight. For example, ethanol, with a molecular weight of 46 (MW), has a boiling point of 78 °C (173 °F), and propane (MW 44) has a boiling point of −42 °C (-44 °F). Such large differences in boiling points indicate that ethanol molecules are more strongly attracted to propane molecules. Many of these differences stem from the ability of ethanol and other alcohols to form intermolecular hydrogen bonds. (See Chemical Binding: Intermolecular Strength for hydrogen bonding discussion.

I. Transesterification
Transesterification is the process by which oil or oil reacts with alcohol to form esters and glycerol. The catalyst is used to improve response rate and productivity. Because the reaction is reversed, more alcohol is used to change the balance on the product.

In our case we use ester as canola oil and Pongamia oil, in addition we have used acid and Methanbal as catalysis.

For Canola oil We have used Alcohol as base and methanal as catalyst, we get product of bio diesel and Glycerol as by product.

For Pongamia oil we have used catalyst as 1. H₂SO₄(5%) 2. NAOH (1%) 3. Methanal (20%), to convert Pongamia oil to biodiesel we have used alcohol as base, here Pongamia act like esters. At the end we get Bio Diesel and Glycerol as By product. Figure 3 shows Separating bio diesel (Canola and catalyst).
Figure 3. Separating bio diesel (Canola and catalyst).

When the mixture contains two or more liquids it is purer than distillation used. Here parts of the liquid mixture evaporate, twist and separate. The mixture is heated and the flexible part burns first. The vapor travels through a condenser and is collected in a liquid state. Figure 4 shows By Product (Glycerol)

Figure 4. By Product (Glycerol)

Glycerol is a simple polyol compound. It is a colorless, odorless, viscous liquid that tastes good and is non-toxic. The backbone of glycerol is found in those lipids known as glycerides. Due to its antibacterial and antiviral properties it is widely used in FDA-approved treatment and anti-inflammatory drugs. Figure 5 shows the Distillation of Pongamia oil and figure 6 shows the Transesterification of canola oil and Pongamia oil.

Figure 5. Distillation of Pongamia oil
Figure 6. Transesterification of canola oil and Pongamia-oil

J. Blends

In Blend We have blend 90:10:2 (Diesel: Canola: Pongamia) in blend 2 We have blend 80:16:4 (Diesel: Canola: Pongamia) in blend 3 We have blend 70:24:6 (Diesel: Canola: Pongamia) Figure 7 shows the B10, B20, B30

Figure 7. B10, B20, B30

K. Property analysis of fuel

In this study properties of canola oil and pungamia oil were determined, 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.

L. Test Specification and Test Procedure

Experimental Testing is going to be carried out in Four stroke cooled diesel engine, Engine speciation shown below.

To achieve stable condition the engine should operate for 10-15 minutes without loading, after obtaining a stable condition the probe is mounted on an exhaust port, heats the engine diesel and the oil is stored at a temperature of around 85 °C.

Engine speed is maintained at 1500 rpm in the case of a given load, then diesel is included in Biodiesel combination P10, P20, P30 and engine performance in different biodiesel components including Electronic Data Acquisition at different load mode, Diesel engine is shown in figure 8.

Figure 8. Single Cylinder Four-stroke VCR Diesel Engine Experimental setup.

3. Test outcome
A. Brake Thermal Efficiency

Brake Thermal Efficiency is defined as the breaking force of a heat engine as a function of thermal insertion from fuel. Used to test how the engine effectively converts heat from fuel to power, the result can be viewed in the form of a graph.

B. Specific Fuel Consumption

Specific Fuel Consumption can be defined as the amount of fuel used for each unit activity, and is also graphic in order to be easily understood.

C. Emission

A pollution test is performed to determine how much air pollution is emitted into the atmosphere in the case of a separate engine load, the main emissions of CO2, CO, NO, HC and evaporation.

D. 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

A. Performance parameter

IC Engine set up under test is a 3.50 kw @ 1500 rpm 1-cylinder Research Diesel engine, with stroke, Speed 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 for various mechanical parameters such as Brake thermal efficiency, mechanical efficiency, specific fuel consumption and emissions. And below, the overall equipment parameter of all three combinations is compared to the Diesel mechanical parameter in the form of a line graph and explained in detail. From the graph below Figure 9 shows the efficiency of thermal conductivity. In the mix, B30 (30% Canola and Pongamia oil and 70% diesel) at a rate of 9 kg at a speed of 1500 rpm gives a very high performance of 30.1 compared to conventional diesel with a heat dissipation of 26% and also higher than other combinations with a load of 9 kg and a speed of 1500 rpm is shown in Table 1.

| LOAD | B10 | B20 | B30 | DIESEL |
|------|-----|-----|-----|--------|
| 3    | 15.54 | 15.44 | 17.54 | 17.99 |
| 6    | 26.51 | 26.89 | 28.9  | 29.7   |
| 9    | 33.88 | 34.910.8 | 36.55 | 36.8   |

Figure 9. Brake thermal efficiency of Biodiesel blends at different loading condition
Figure 10 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 B30 (30% canola and Pongamia oil 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 is shown in Table 2.

| LOAD | B10 | B20 | B30 | DIESEL |
|------|-----|-----|-----|--------|
| 0    | 0.51| 0   | 0.72| 0.65   |
| 3    | 13.49| 14.84| 13.69| 13.7   |
| 6    | 23.37| 32  | 22.68| 28.6   |
| 9    | 32.32| 32.98| 25.08| 31.4   |

**Table 2.** Mechanical efficiency of biodiesel blends at different loading condition

Figure 11 shows the specific fuel consumption (SFC), of the biodiesel blends at the varying load condition, it shows that specific fuel consumption of blends of canola oil and Pongamia oil is decreased with the increase in the load, decreasing of the specific fuel consumption is mainly because of large calorific value of the palmarosa oil, density also places a major role in the SFC reduction is shown in Table 3.

| LOAD | B10 | B20 | B30 | DIESEL |
|------|-----|-----|-----|--------|
| 0    | 16.39| 0   | 11.96| 17     |
| 3    | 0.62 | 0.57| 0.63 | 0.8    |
| 6    | 0.37 | 0.26| 0.38 | 0.5    |
| 9    | 0.26 | 0.26| 0.34 | 0.4    |

**Table 3.** Performance parameter

Figure 11. Performance parameter
A. 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 and figure 12 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.

![Figure 12. Emission of CO in biodiesel blend at different loading condition](image)

Figure 12 shows the emission HC of different biodiesel blend in ppm, and this investigation shows that the biodiesel blend of B20 (20% Canola oil and Pongamia with 80% diesel) has 26 ppm which is comparatively minimum than the other biodiesel blend and diesel, and the B20 oil has the constant emission in the different loading condition compare to other oil ratios.

![Figure 13. 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 14, the test shows that the biodiesel mixture of B30 (30% Canola oil and Pongamia & 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 14. NOx Emission of biodiesel blends at different loading condition.

The main pollution causing factor to the environment is CO2, and below graph figure 15 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 B30 has the minimum emission of CO2 at the 9 kg load condition and speed of 1500 rpm.

Figure 15. CO2 emission of Biodiesel blends at different loading condition.

5. Cost analysis

Cost analysis of B10, B20, B30 is shown in below table. One of the main parameters for selecting low-cost petrol oil, in order to obtain the lowest fuel, cost analysis is one of the various diesel compounds and compared to standard diesel, below Table 4 shows the diesel cost analysis and biodiesel comparisons. Figure 16 shows the Cost analysis.

Table 4. Cost analysis of different Blends

|          | B10 | B20 | B30 |
|----------|-----|-----|-----|
| Diesel (Rs) | 78.1 | 69.6 | 60.9 |
| Canola (Rs) | 7.2  | 14.4 | 21.6 |
| Pongamia (Rs) | 1    | 2    | 3    |
| Total (Rs)   | 86.5 | 86   | 85.5 |

Figure 16. Cost analysis

6. Conclusion
After performing various tests in IC engine (Single-cylinder Four-stroke diesel engine) at various test conditions 0 kg, 3 kg, 6 kg, 9 kg we have concluded that below results:

Mechanical efficiency and Brake Thermal efficiency is slightly increased by 15% of the B10 (10% of Canola and Pongamia biodiesel mixed with 90% of diesel), and this is mainly due to fuel properties like lower density, lower viscosity, the higher calorific value of Canola and Pongamia 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 9 kg load condition, reduction in specific fuel consumption is because of faster combustion and evaporation of Canola and Pongamia than diesel.

- There is no noticeable variation in the emission, but compare to diesel, B10(100% Pongamia and canola mixed with 90% diesel) has a significant reduction in the NOx by 134 ppm, THC by 26 ppm, compared to diesel the incomplete combustion is comparatively less.
- CO is reduced by a minimum different compared to diesel.
- Cost analyses of Biodiesel blends and diesel, shows b10 Canola oil and Pongamia oil blend has total cost value of Rs. 86.5, which is comparatively lower than normal diesel value (Rs. 90).

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