Comparison and Analysis of Custard Apple Seed Oil with Engine Lubricant (Bio Lubricant)

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Abstract. Now a day’s the prices are increase and the decline of fossil fuels is generating a great deal of need to find an alternative lubricant from non-edible oil seeds. To order to solve the issue of energy shortages, an alternative energy source must be required. Vegetable oils are perceived to be alternatives to mineral oils for lubricant base oils because of certain inherent technical properties and their biodegradability. Vegetable oils with high oleic contents are considered to be the best alternative to substitute conventional mineral oil-based lubricating oils and synthetic esters. This paper mainly reveals about extraction of oil from custard apple seeds and the study of its composition and physic-chemical properties. Custard apple seeds were tested for their physicochemical properties in the production of biological lubricants. Research indicated that 27.5 percent of oil content in the seeds. The bio lubricant was analyzed for a quality test such as density, viscosity, flashpoint, fire point, calorific value.

Key Words: SAE 20W 40 Oil, Custard Apple Seed Oil, Flash Point, Fire Point, Calorific Value, Density Viscosity

1. Introduction

Energy is the most fundamental requirement of human existence. Fossil fuels have been used massively and their use has also had a big environmental impact. It is observed that the specific fuel consumption of the brakes increases with a higher percentage of bio-lubrication in the blends. In order to meet the growing demand for fossil fuels for transport, environmentally friendly alternative energy sources need to be developed. The most accepted route is the use of vegetable oils as bio-lubricants. The yield and quality of the bio-lubricant depend on the quality of the feedstock, especially the moisture content and the free fatty acid (FFA) content. This bio lubricant’s performance, emission and combustion qualities, and its different blends of mineral fuel, are compared with base data in the diesel engine of direct injection (DI). This made it possible to reconsider and explore alternative fuels from sustainable and environmentally friendly recycled materials and non-food feedstock [1-6].

Bio-lubricant is made from various feed materials such as vegetable oil, animal fat and oil seeds. Indeed, the manufacture of alternative fuels for use in internal combustion engines has traditionally been an evolutionary method for solving fuel problems and for defining important fuel properties and for deciding precise limits to fix the problem. In this respect, the present work presents the view of the features of lemongrass oil combustion. In the nutshell, the combustion dynamics of lemongrass oil were studied at 1500 rpm engine speed and 17.5 rpm compression ratio in a 4-stroke compression ignition engine [7-8].
Diesel fuel has a finite supply, so worries over environmental contamination contribute to the use of 'bio-origin fuels' because they are sustainable so environmentally friendly. Palm oil methyl ester, an esterifies biofuel, has an outstanding cetane number and a fair calorific value. In addition, palm oil methyl ester (C18.07H34.93O2) has around 11. 25 per cent of oxygen bonded in its molecular structure, which enhances its burning intensely. The blends are used to run a single cylinder CI engine and the performance and emission characteristics were studied and compared at different load conditions. Results showed that for the B20 blend results in better performance and lower emissions. The reason for B20 to give better performance is due to extra amount of oxygen that is present in the blend and for B30 to decrease in performance is due to increased viscosity of the fuel. And hence possibilities of homogeneous mixing decrease and combustion efficiency falls down. The engine emission such as carbon monoxide, hydrocarbons, oxides of nitrogen and smoke emission were comparable to diesel operation [9-10].

Nowadays, rising costs and the decline of fossil fuels make it very important to find substitute fuel (bio lubricant) from non-edible oil seeds. Custard seed oil is characterized by an analysis of the gas chromatograph (GC) and essential properties of biodiesel, such as density, flash point, pour point, cloud point and kinematic viscosity, ash content, carbon residue and by comparison with ASTM-biodiesel standards and commercially available diesel. The study encourages the production of biodiesel from Custard seed (Annona squamosa) Oil and value addition of custard seed oil [11-12]. Therefore, the main objective of this paper is to protect the environment. Due to continuous use of oil extracted from earth crust we are in a need to find an alternative for the engine oil. The aim of the project is to use the seeds which are treated as waste. In this project, we are working to promote and achieve the efficient bio lubricant for the beneficial of the environment.

In this work we have done a process of comparison of SAE20 40 engine oil and the custard seed oil. By mixing both the samples we are been able to identify the Flashpoint, Fire point, Calorific value, Density and Viscosity.

2. Experimental procedure

2.1 Custard Apple Seed

Custard is a common name for the fruit, Figure 1 shows the custard apple and the tree that bears the fruit is reticulated by Annona. It is often mistakenly referred to as sweetsop, sugar apple and by Spanish-speaking people, anon in India, Ramphal. It is upright, with a rounded or spreading crown and a trunk of 25 cm to 35 cm thickness. The custard apple is thought to be native to the West Indies, but was brought back to Southern Mexico in the early days of Central America. It was grown and naturalized in Peru and Brazil for a long time. It is commonly cultivated in the Bahamas and sometimes in the Bermuda and Southern Florida areas. Presumably, it was introduced to tropical Africa at the beginning of the 17th century and is cultivated as a fruit tree in South Africa. In India, the tree is cultivated, particularly around Calcutta, and is wild in many areas. Table 1 shows the fatty acid composition of sugar apple seed oil.

| S. No | Fatty acid composition | % Weight |
|-------|------------------------|----------|
| 1     | Lauric acid (C12:0)    | 0.08     |
| 2     | Palmitic acid (C16:0)  | 17.79    |
| 3     | Stearic acid (C18:0)   | 4.29     |
| 4     | Oleic acid (C18:1)     | 39.72    |
| 5     | Linoleic acid (C18:2)  | 29.13    |
| No. | Fatty Acid           | Value |
|-----|---------------------|-------|
| 6   | Arachidonic acid    | 1.06  |
|     | (C20:4)             |       |
| 7   | Linolenic acid      | 1.37  |
|     | (C18:3)             |       |
| 8   | Behenic acid        | 2.01  |
|     | (C22:0)             |       |

**Figure 1** Custard Apple

### 2.2 Parameters
- Flash Point
- Fire Point
- Calorific Value
- Density
- Viscosity

### 3. Instruments
#### 3.1 Flash point
Flashpoint is the lowest temperature at which a liquid can form an ignitable mixture in air near the surface of the liquid. The lower the flashpoint, the easier it is to ignite the material. Figure 2 shows the flash point apparatus used for determination of flash point and fire point of petroleum products except fuel Oil.

**Figure 2** Flash Point

#### 3.2 Fire Point
The fire point of a fuel is the lowest temperature at which the vapour of that fuel will continue to burn for at least 5 seconds after ignition by an open flame. Figure 3 shows the apparatus used to find out the fire point. At the flash point, a lower temperature, a substance will ignite briefly, but vapor might not be produced at a rate to sustain the fire.
3.3 Calorific Value

The calorific value is the total energy released as heat in standard conditions if a substance is fully combusted with oxygen. Typically, the chemical reaction is hydrocarbon or other organic molecule reacting with oxygen to form carbon dioxide and water and release heat. It may be expressed with the quantities. Figure 4 shows the apparatus used to find out the calorific value.

3.4 Viscosity

Viscosity can be conceptualized as quantifying the frictional force that arises between two adjacent layers of fluid that are in relative motion. Figure 5 shows the device used to find out the viscosity of the oil. For instance, when a fluid is forced through a tube, the fluid flows more quickly near the tube's axis and more slowly near its walls. In such a case, experiments show that some stress (such as a pressure difference between the two ends of the tube,) is needed to sustain the flow through the tube. This is because a force is required to overcome the friction between the layers of the fluid which are in relative motion: the strength of this force is proportional to the viscosity.
4. Results and Discussion

The main factors to consider in the development of bio-lubricants are moisture and free fatty acid. The presence of higher moisture and free fatty reacts with the catalyst, resulting in the formation of soap (saponification). The conversion needs 25-35% of oil content in seeds. By using solvent extraction and mechanical expeller, oil from custard apple seed was extracted. The properties of different blends were shown in Table 2.

The amount of oil content in custard apple (Annona squamosa) seed was 26-27.5 per cent. The solvent extraction oil percentage (5.5-ml oil for 20 gms of seed and 275-ml oil for 1,000 gms of seed) was found to be. The mechanical expeller accounted for 26 percent (1300ml of oil per 5kgs of seed). The oil content varies a lot, but in the case of custard apple, there was a discrepancy between the two methods.

The quality of fat or oil depends on free fatty acid composition, with an impact on the Carbon-Hydrogen Ratio, the quality of burning and the oil viscosity. It has been found that the colour of biodiesel is golden yellow and the viscosity that controls the flow of the fuel has a high viscosity that decreases the flow of fuel to the engine. The result was compared to the ASTM standard value sand test, which showed that the organic lubricant obtained from the custard apple seeds was on a par with the ASTM standards.

Table 2 Properties values of at various blends

| S. No | SAE 20W 40 Oil | SAE 40+Custard Apple Oil 2.5% | SAE 40+Custard Apple Oil 5% | SAE 40+Custard Apple Oil 7.5% |
|-------|----------------|-----------------------------|-----------------------------|-----------------------------|
| Density (kg/m³) | 922 | 911 | 909 | 907 |
| Viscosity (mm²/s) | 75 | 77.95 | 78.4 | 79.25 |
| Calorific value | 43400.9 | 41402.94 | 40431.99 | 39722.62 |
| Flash point °C | 200 | 242 | 252 | 262 |
| Fire point °C | 212 | 257 | 263 | 278 |

Discussion in this study the amount of oil content from Annona squamosa seed was found to be satisfactory (28.86%). The iodine value and cetane number of were also found to be within the permissible range. The degree of unsaturation, expressed in terms of the iodine value, is another criterion for selection bio lubricant. The pressure of a little unsaturated fatty acid component in methyl ester is desirable as it restricts solidification to some extent. Cetane number is the ability of the fuel to ignite quickly after being injected. Higher the cetane number is better is the ignition quality of fuel. The methyl ester obtained from Annona squamosal seed oil meets this specification. Annona squamosal seed oil is free of soap and is primarily converted to methyl esters by GC-Ms analysis.

Figure 6 Comparison of density of Engine oil with Custard Apple Seed oil at various % blends
Figure 6 shows the graphical representation of the comparison of density of engine oil with custard apple seed oil at various % blends. In this bar chart we plot the density of three different samples of custard apple seed oil mixed with SAE20W 40 engine oil. Blue bar represents the density of engine oil we are using in this experiment which is about 922 kg/m$^3$. Red bar represents the blend of SAE 40+custard apple oil 2.5% and obtained density is 911 kg/m$^3$. Green bar shows the density as 909 kg/m$^3$ for blend SAE 40+custard apple oil 5%. From the bar chart, the density of the blended oil increases. The result obtained are minimum value SAE 40, maximum value SAE 40+Custard Apple Oil 7.5% blend.

Figure 7 shows the graphical representation of the comparison of viscosity of engine oil with custard apple seed oil at various % blends. Blue bar represents the viscosity of SAE 40 engine oil that is 75 mm$^2$/s. Red bar represents the blend of SAE 40+custard apple oil 2.5% and obtained viscosity is 77.95 mm$^2$/s. Green bar shows the viscosity as 78.4 mm$^2$/s for blend SAE 40+custard apple oil 5%. Violet bar shows the viscosity as 79.25 mm$^2$/s for the blend SAE 40+custard apple oil 7.5%. Final result obtained is that the viscosity values have been increased in the blend. The values are: minimum value SAE 40, maximum value SAE 40+Custard Apple Oil 7.5% blend.

Figure 8 shows the graphical representation of the comparison of calorific value of engine oil with custard apple seed oil at various % blends. We can see a gradual reduction in the values obtained. For SAE 40 oil it shows the highest value, which is off 43400.9. While mixing the various blends we can see a reduction in the calorific value obtained. Least value obtained is 39722.62 for blend SAE40+custard apple oil7.5%. So, the final findings state that the Calorific value have been reduced in the blend. The values are maximum value SAE 40, minimum value SAE 40+Custard Apple Oil 7.5% blend.
Figure 9 Comparison of flash point of Engine oil with Custard Apple Seed oil at various % blends

Figure 9 shows the graphical representation of the comparison of flash point of engine oil with custard apple seed oil at various % blends. And Figure 10 shows the graphical representation of the comparison of fire point of engine oil with custard apple seed oil at various % blends. Comparing both flash and fire point, it shows same properties for the given blends. Final results states that the values of Flash Point and Fire Point has been increased, the values are minimum for SAE 40 and maximum value for SAE 40+Custard Apple Oil 7.5% blend.

Figure 10 Comparison of fire point of Engine oil with Custard Apple Seed oil at various % blends

5. Conclusion

Conventional mineral oil-based lubricants are highly harmful to the biosphere when they enter the environment. Due to poor degradability, mineral oils have remained in the ecosystem for a long time. Except in the case of high dilution, the result would be fatal (ecotoxicological result). A higher amount will clearly be required for the elimination of contaminated ecosystems. Eco-friendly hydraulic oil, refrigerator oil, transmission oil, brake oil, two-stroke engine oils, food-processing and water-management lubricants and eco-friendly fats for both general and multipurpose purposes can be commonly used. The industry will quickly introduce green-friendly biodegradable lubricants to replace mineral oil and other non-biodegradable goods in these countries, which are currently being used to combat excessive contamination caused by them. Edible oils used in developed countries, such as the USA and European nations, but in
developing countries, the production of edible oils is not adequate. For a country like India, there are many plant species whose seeds are still unused and underutilized for the production of biodiesel. Non-edible oil seeds are a possible source of food for the production of bio-lubricants in India.

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