Extracted Handal seed oil (Cittrullus Seeds) used as biodiesel fuel in internal combustion engines

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Abstract: *Most important of fuel economy research and vehicle industry today is to find a unique fuel with high calorific value and low tail pipe emissions . in this research a good effort was spent to find a solution for automotive industry by presenting a new fuel which was extracted from Citrullus and presented as handle seeds oil to be used as bio fuel in internal combustion engine, which is very important issue for automotive industry . The importance of extracting Handel oil has led to investigate the characteristics of chemical and physical properties of new fuel, such as density, specific gravity, kinematic viscosity, flash point, pour point, cloud point, which will help of controlling the composition of biofuel and improve the fuel quality which can be used in internal combustion engines . The two important processes were used for biodiesel production are Esterification and Transesterification.*
KEYWORDS*: , HANDAL SEED OIL , BIOFUEL*

1. Introduction

Biodiesel as promising fuel in the future and replacing diesel fuel as diesel is described as fatty acid methyl or ethyl esters (FAME) from vegetable oils or animal fats. One of the most important properties to characterize fuel is its energy content (1) . Biodiesel is fuel made of plant or animal oils. There are several non-edible oils, animal fat and vegetable oil sources for biodiesel production. Jatropha plant/oil seed containing 27-40% oil while the residue (press cake) can also be processed and used as biomass feedstock to power electricity plants or used as fertilizer as it contains nitrogen, phosphorus, and potassium (2) .

Biofuel can be blend with diesel and be used in compression engines leading to lower exhaust emissions with similar power (3) ; biodiesel has a technical advantage such as less exhaust emission and toxicity, biodegradability, a derivation from a renewable and domestic feedstock, negligible sulfur content, superior flash point, higher combustion efficiency and they would not require a significant modification of existing engine hardware (4) .

Therefore, nonedible plant oils become very promising alternative feedstocks for biodiesel production because of the large demand for edible oils as food, the higher prices of edible oils than that of fossil fuels, and the lower cost of non-edible oil plant cultivation . Biodiesel production has derived from forestry, agriculture, and agro-industrial wastes that exhibit good properties as feedstocks (5)

The transesterification process depends upon a number of process parameters that are required to be optimized in order to maximize the biodiesel yield, such as molar ratio, catalyst concentration, reaction time, and reaction temperature (6) . But before converted the oil to biodiesel the main problem faced vegetables crude oil is particles, impurities, moisture, and high content of free fatty acids, so they must be removed from the crude Hndal oil before converted to biodiesel. Gums should be separated from the oils to make the oils suitable for use as fuel. The use of crude oil without pretreatment can cause problems such as emulsification in the transesterification process (7) , it becomes imperative to analyzed the sunflower methyl ester (SFME) and its blends as an alternate source of fuel for diesel engines. Biodiesel was prepared from sunflower oil by base transesterification. Four- cylinder Deutz F4L912 diesel engine was used to perform the tests on various blends of sunflower biodiesel. The emissions of CO, HC were lower than diesel fuel for all blendstested. The NOx emissions were higher due to the high volatility and high viscosity of biodiesel.

Others blended biodiesel from Citrullus lanatus with petro-diesel, thereby forming blends of different percentages, 5%, 10%, 15%, 20%, and 25%. The calorific values of the biodiesel and blends were all within the ASTM standard with B20 value slightly below that of pure diesel; similarly, the flash point of the pure biodiesel and its blends were above the pure diesel value but falls within the ASTM range. The fuel was safe to handle during storage because it cannot easily spark when exposed to flame and hence they were recommended for use in the CI engines. The pour points of all the fuel samples conform to the ASTM standards. The cetane numbers are all greater than that of pure diesel and conform to ASTM standards. The biodiesel will be having the shortest possible ignition delay when they burn in the CI engines. (8).

2. Work process

2.1. Collection

The samples were collected from different area in Jordan such as Wadi Ram, Al Baydah and Al Deseh of Maan city south of Jordan as well as Azraq east of Jordan .

2.2. Preparation

Plenty of handal were collected and reserve 20 kg to be used, Hndal Samples were smashed with taking the seeds out and cleaned. Then seeds were dried for three days at room temperature, and then were ground using an electric blender .

2.3. Extraction of oil

First sample was 2 kg of grind seed to be used for extraction purposes. Hundred gram each of grinned seed was packed into the thimble of the soxhlet extractor that incorporates a condensation system . Hexane (extraction agent) is heated to reflux in the distillation flask, the vapors are condensed in the reflux condenser and drop into the chamber containing the thimble with the material to be extracted. The chamber slowly fills with the warm solvent and some of the material is dissolved in the solvent. When the Soxhlet chamber is almost full it is automatically emptied by a siphon sidearm, with the solvent running back down to the distillation flask. This cycle is repeated several times to enrich the solvent in the distillation flask with the extracted material. The mantle heater was set at 60oC close to the evaporation temperature of hexane (64oC).

2.4. Samples Production

The amount of NaOH required for the transesterification of the oil. ca 1 ml oil was dissolved in 10 ml isopropanol and titrated with 0.1M NaOH solution (standardized against KHP). A suitable mass of the catalyst-based on above titration is dissolved in methanol (NaOH: Methanol: Oil; 0.0016 g:0.2ml:1ml) with 20 min vigorous stirring until dissolve all NaOH to prepare methoxide (CH_3O^-). Then, this mixture is transferred to the reactor (R-flask) containing treated moisture-free oil.

2.5. Esterification Process

In this work, the procedure of known researcher for the esterification process was followed (9) . Titration solution was prepared by adding 1 gram of potassium hydroxide to 1 liter of distilled water. In a small beaker, 1 ml of oil was added to 10 ml of ethanol and was stirred well to get a mixture. 2 drops of phenolphthalein were added as an indicator to the mixture. KOH solution was poured drop by drop by a burette to the mixture until it turns into a pink solution.

It is the most commonly used and important method to reduce the viscosity of vegetable oils. In this process, triglyceride react with three molecules of alcohol in the presence of a catalyst producing a mixture of fatty acids, alkyl ester, and glycerol. The process of removal of all the glycerol and the fatty acid from vegetable oil in the presence of a catalyst is called esterification (10) . glycerol from the bottom of the funnel and pour the top layer (crude biodiesel) back into the beaker .

2.7. Washing process

In this process, water is used for purification, thus, warm distilled water was added to the separator funnel that contains crude biodiesel. Then the separator funnel was shacked gently to mix water with crude biodiesel. Allow the water to settle down of the biodiesel for one day. The water was drained out and the washing process was repeated for 3 to 4 more times until the water has completely become transparent. To remove undesired components such as the excess methanol or existing water, the washed biodiesel samples were dried at 110 ° C for 2 hrs

3. Results and Discussion

The results for the comparison of the properties of the biodiesel produced from used vegetable oils and those from diesel fuel are discussed as follows:

3.1. Density

The density of Handal oil is 899 kg/m3, whereas in biodiesel was measured is 888kg/m3. It is higher than that of standard diesel (820-870 kg/m3).

The limit value proposed in pre-standard Fuels for vegetable oil compatible combustion engines - Fuel from rapeseed oil ranged between 900 to 960 kg/m3, so as not to exclude vegetable oils such as castor, jatropha, mahua, neem, or babassu oil , it was mentioned that, indicating density of Handal agrees with pre-standard Fuels for vegetable oil compatible combustion engines- Fuel. (11)

3.2. Specific gravity

The specific gravity of Hndal oil is 0.898 at 20°C, while in biodiesel was observed is 0.886. The Specific gravity of Thumba oil slightly variable between 0.880 and 0.905.

3.3. Kinematic viscosity

The significant physical properties of Hndal oils indicate that the kinematic viscosity of Hndal oils is 16.49 cSt at 40° C, which is an order of magnitude almost 4 times higher than that of diesel.

Viscosity is a rapid indicator of fuel quality before use, especially if the nature of the feedstock is not well known, or if the oil could have been deteriorated or polymerized during storage . The kinematic viscosity of Handal oil is higher than that of conventional diesel fuel but lower than that of heavy fuel oil. (12)

3.4 Flash point

The flash point of Handal oil is very high (above 180 °C) and the heating values are in the range of 39.603 MJ/kg, while biodiesel was measured is 39.5, as compared to diesel fuels which is about 66 MJ/kg. The used Handal biodiesel oil had a flash point (0C) of 49.5 and was lower than that, Petroleum diesel, Diesel fuel, and fossil diesel, which had values of, 68.3, 68, and 47 C°, respectively.

3.5. Pour point

The pour point of Handal oil value is -9 0C, whereas biodiesel value is +3. The results observed that the vegetable oil shows the least values of pour point ranging from -9 °C to 40°C, while the Pour point of the used Thumba oil was -8, and lowers than that of Thumba biodiesel which is -12. The corn oil had the pour points is -40°C while the Jatropha oil and Karanja oil have to pour point values 8°C and 6 C°, respectively (Table 3). Vegetable oils can be mixed with conventional diesel in any proportion and blends can be used successfully in engines (13). It can be concluded that all the chemically modified oil products have the pour points below 0°C which is a desirable property for lubricating oil. The pour point obtained (12°C) is still much higher than that is required for any lubricant application (-6°C for two- stroke engine lubricant as per IS14234) (14).

4. Conclusion

4.1.A lower viscosity and density was observed by dilution of handal oils with diesel oil., flash points of handal oils blends were higher than that of diesel oil.

4.2. The Handal oils exhibit relatively different flash point, cloud point, pour point, and sulfur content.

4.3. Handal oil showed have high energy content and obviously good fuel properties,

4.4. The treated handal oils, could be converted into biodiesel, which has properties suitable for application in diesel engines

4.5. The transesterification process has been the most suitable and acceptable method for biodiesel production

4.6. The density of Handl seed oil agrees with pre-standard Fuels for vegetable oil compatible combustion engines- Fuel.

4.7. The kinematic viscosity of Handal oil is higher than that of conventional diesel fuel but lower than that of heavy fuel oil

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