Experimental Analysis of Cottonseed Biodiesel

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ABSTRACT

Nowadays as we see the use of mineral resources is increasing day by day and these oils are available in limited quantities in the world. India's use of power is fourth in the world. Biodiesel and bioethanol appear to be promising sources of energy for the future. Biodiesel, the most promising diesel fuel, has received much attention in recent years because of its following characteristics: biodegradable, renewable, non-toxic, low emissions, and particles with higher cetane content than conventional diesel. The search for a sustainable source other than petroleum technology and its refining has encouraged the development of biofuels, such as biodiesel, from the transesterification process of new or used vegetable oil.

This work is dedicated to the study of transesterification of used vegetable oil and the efficiency of various parameters affecting biodiesel compounds, such as the molar component (alcohol / oil), the amount of catalyst and the percentage of weight, type. alcohol, temperature T (° C) and reaction time. From this perspective, the current important target function is to advance the initial conditions for the transesterification of fatty acids to form biodiesel in used vegetable oils. Various physicochemical factors (density, viscosity, cetane number and flash point) were investigated to determine biodiesel compliance with international standards and commercial biodiesel.

The biodiesel diesel mix is usually defined by the letters "B" followed by the percentage of biodiesel in the mixture; so, if 20% biodiesel and 80% diesel in a blend based on volume and defined as B20. Biodiesel as an alternative to fuel, is the cost of crude oil that is very high and varies daily. This leads to growing awareness in the field of biodiesel development and development countries. Biodiesel from different feedstock should be mixed with diesel fuel in different proportions e.g., B20, B30 and B40.

Keywords: Transesterification, Feedstocks, Esterification, Blend

1. INTRODUCTION

With declining oil resources and the global fuel crisis, the world is turning to biofuels, biodiesel being the leading biofuel. Biodiesel can be easily a transesterification reaction. Reactions occur when there is alcohol and catalyst, alcohol preferred by Methanol or Ethanol, various types of homogeneous and heterogeneous catalysts can be used. It is a simple production process and its various advantages compared to petrol and diesel make it unique in other types of fuel. The production of biodiesel requires basic resources such as stirring and heating which makes the process much easier.

The direct use of vegetable oils or animal fats which includes fuel can cause many engine issues consisting of atomic power failure, incomplete combustion, engine harm and contamination of lubricating oils, resulting in excessive visibility. consequently, the viscosity of vegetable oils may be decreased in some of ways which includes oil blending, micro emulsification, precipitation / pyrolysis, and transesterification. Amongst these transesterifications is broadly used in business manufacturing biodiesel. Blending Biodiesel blends trendy petroleum diesel with biodiesel to provide a biodiesel combo that can be delivered to any petro-diesel element. This article discusses how the performance of diesel engines uses biodiesel with a mixed B20, B30 and B40 percent. The variant is designed to reduce the high viscosity of Cotton Seed oils. The high viscosity of the fuel can enable the fuel injector toget fuel to the cylinder effectively.

The performance of the diesel engine is another test of the engine value to be considered as this affects the process of burning and exhausting the diesel engine. Generally, performance analysis has at least 5 variable results, namely Power, Specific Fuel Consumption (SFC), Break Mean Effective Pressure, Temperature Performance and Torque. It is intended to facilitate the analysis of emissions and fire process data generated in the next step of the study. This simplification is done by selecting the test parameters for the combustion process and extracting the maximum measuring power.

2. LITERATURE REVIEW AND OBJECTIVE

Mohapatra, Saroj & Singh, Sandeep & Sharma, Sumeet, et.al. [2015] had published their work, "A production of biodiesel from waste cotton seed oil and testing on small capacity diesel engine". In their work, they derived that the cotton seed biodiesel can be used as an alternative fuel to the diesel engine without modification. Experimental studies were performed to determine the effect of blends (B10, B15, B20) on cotton biodiesel and diesel seeds on engine performance. A transesterification process to produce methyl ester seed oil was investigated. The results showed that biodiesel obtained under

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Duple Sinha, S. Murugavelh, et.al. [2016] had published their work, “Biodiesel production from waste cotton seed oil using low-cost catalyst: Engine performance and emission characteristics”. In their work they studied that, the highest yield of 92% biodiesel was reported when the reaction temperature, time, methanol / oil ratio and catalyst loading were 60 ° C, 50min, 12: 1 and 3% (wt.%), respectively. The calcined eggshell catalyst was prepared and marked. The partial purification of fatty acid methyl esters was proposed to increase biodiesel purity and better engine performance. The flash point and biodiesel temperature range were 128 ° C and 136°C, respectively. Christian, Konfo & Agbangnan D., C. Pascal & Dominique, Sohounhloué, et.al. [2018] had published their work, “Comparative Study of Transesterification Processes for Biodiesel Production”. In their work they derived that due to the environmental problems caused using fossil fuels, attention has been given to the production of biodiesel as an alternative to Petroleum diesel. Biodiesel is an environmentally friendly diesel fuel made from renewable fuels made from vegetable oils and animal fats. It is a renewable energy source that seems to be the ideal solution for global energy needs. The current method of biodiesel production is the transesterification of non-alcoholic fats (methanol or ethanol) in the presence of catalyst or not. The transesterification reaction is highly sensitive to the parameters and nature of the oil such as acid composition and free fatty acid content. Other variables include reactions such as temperature, alcohol content in vegetable oils, catalyst, and solubility, purity of reagents. The development of biofuels creates new agricultural sectors and can provide new markets for farmers in usable areas. This study aims to conduct a comparative study of transesterification processes for biodiesel production. Awad, Ahmad & Badran, Omar & Al-Adwan, Ibrahim & Rahma, Abu & Alaween, Ayman & Anwar, Al-Mofleh, et.al. [2020] had published their work, “Experimental Study on the Performance of Diesel Engine using Different Alternative Fuels”. In their work they focused on test results for different diesel compounds (Diesel + alcohol). Investigate the performance of a diesel engine on different concentrations of ethanol and methanol in diesel. Different diesohol mixtures (5%, 10%, 15%, 20%, and 25% ethanol and diesel methanol) were tested and compared with pure diesel samples. The test was performed using a four-stroke (1400 cc) 8 hp and a 1-cylinder diesel engine test bed. Amazing results have been obtained regarding various operating conditions such as torque, thermal efficiency, and fuel consumption. Experimental results obtained concluded that diesohol compounds improved torque and efficiency of engine temperature compared to pure diesel sample.

Belion, Kosgei & Mensah, Patrick & Akwaboa, Stephen & Woldesenbet, Eyassu & Stubblefield, Michael & Adjaottor, Albert, et.al. [2014] had published their work, “Engine Performance and Emission Products of Pure Diesel and Multi-Feedstock Blended Biodiesel”. In their work the focused on comparing the engine performance with the output effects of various pure diesel compounds and multifeedstock (MFS) biodiesel when used in an air-cooled, single-cylinder diesel engine. The engine is integrated with a torque measurement dynamometer Nitrogen Oxide (NOx) emissions, Hydrocarbons (HCs), Carbon monoxide (CO) and Carbon dioxide (CO_2) - are rated and presented near operating systems including fuel-specific fuel use (BSFC), engine efficiency, torque. and power. Test results show that, compared to diesel, biodiesel decreased by 3 - 24% in torque, decreased power by 4- 11%, increased BSFC by 11-32% and a typical reduction of engine by 8- 29%. However, biodiesel reduced CO emissions (1.5 - 6%), CO_2 (13 - 34%) and unburned HCs (3-25%), while NOx emissions increased significantly (12-48%).

Objectives:

1. To prepare biodiesel from cottonseed oil by transesterification process.
2. To study type of catalyst, reaction temperature and catalyst concentration on reaction.
3. To take readings on a diesel engine for pure diesel.
4. To prepare blends of diesel and biodiesel as B20, B30, B40.
5. To test different blends of biodiesel on a diesel engine.
6. Evaluate overall engine performance with these fuels compared to the petroleum diesel: Power, torque, fuel consumption and emissions.
7. Evaluate potential effects on durability of engine, injection system and fuel system.
8. To compare parameters such as efficiency, emissions, power, and losses of prepared biodiesel with pure diesel.

3. METHODOLOGY

The preparation of biodiesel included following steps and was carried out as follows:

Extraction Of Cottonseed Oil: The processing of cottonseed oil mainly involves the process of flow production, seed cleaning, cracking, stirring, cooking, expulsion, and refining.

Filtration Of Cottonseed Oil: Eliminate organic pollution, non-living pollutants, oily contaminants. In this section we use Magnetic Separator, Vibrating Filter, destoner and adapter. By cleaning up pollution, you can reduce oil loss & improve oil yield and crop production environment. The materials produced after the pre-treatment contain contaminants ≤ 0.1%.

Determination of Acid Value: In 1000ml pure water 56.11g / mol of KOH is added 0.1 standard. The solution was made by adding 5.611g / mol of KOH to 1000 ml of normal 0.1 ml of distilled water. 100ml of the prepared solution is taken from the burette. 1 gram of cotton seed oil and 1 or 2 drops of phenolphthalein index is taken from a conical flask and mixed. 1 gram of oil was reduced against the normal potassium hydroxide solution using the phenolphthalein index. The amount of fatty acid was determined by knowing the relative weight of KOH. The acidic value of crude oil is determined by dividing the acid number by 2 as shown in eqn. where free fatty acid (FFA) is found in oil content. FFA content is determined using a formula. Free Fatty Acid = Amount of Acid / 2

Acid Esterification: The oil is taken around the lower flask and heated to 650C. Methanol and sulfuric acid are mixed separately and stirred. Then the mixture is added with oil to the set. Stirrer is turned on and the reason happens for 90 minutes. After 90 minutes, the product is removed and allowed to sit on a separation flask for 8 hours. The methyl ester is found in the lower part and the part will be removed. Acid esterification determination is shown in fig 4. The acidity of esters is determined. The esterification process is performed for the various concentrations of H2SO4 and the ratio of fat to methanol. The amount of acid and free fatty content is determined in each case. The diagram shows the preparation of esterification products, in which the methyl ester is found in the lower part.

Base Transesterification: The process of transesterification is made up of alkaline metal alkoxides and hydroxides. Alkaline metal alkoxides base catalysts are highly effective as they provide the highest yields (> 98%) with a short reaction time (30 min) even when used in low molar concentrations. Calcium oxide is the most widely used biodiesel catalyst than the more than 60% of the industrial plants that use this catalyst. Fig5 shows base transesterification. The methyl ester produced by the acid esterification is transferred to a biodiesel reactor and the catalyst / alcohol mixture is dissolved in the oil. The final mixture is stirred vigorously for 45 minutes at 550C at ambient pressure. An effective base esterification reaction produces a two-phase ester and crude glycerol as shown in fig. The biodiesel yield is determined. Base catalyst esterification is repeated with various concentrations of base catalyst and methanol. Yield biodiesel is determined in each case.

Biodiesel Purification Process: The reaction mixture after base esterification was allowed to settle in the reaction vessel to allow for the initial separation of biodiesel and glycerol or the mixture being thrown into the solution vessel. The glycerol phase is much thicker than the biodiesel phase and remains at the bottom of the reaction vessel, allowing it to be separated from the biodiesel phase. Understanding the limitations of biodiesel purification methods and choosing the right combination of feedstock and purification measures, will lead to consistent fuel quality at a cost that both manufacturer and customer can afford.

Recovery Of Glycerol: All the mixture in the seating tank then settles and the glycerol is left on the floor and the methyl ester (biodiesel) is left on top. The phase separation is completed within 2 hours after stimulation. Complete repair can take up to 18 hours. After the dissolution is complete, water is added at a rate of 5% by volume layer remains. The acquisition of high-quality glycerol as a biodiesel product is a major factor that should be considered to reduce biodiesel costs. By reducing free fatty acids, removing glycerol, and creating an alcohol ester, transesterification is possible. This is achieved by mixing methanol and sodium hydroxide to form sodium methoxide. This harmful liquid is then mixed with vegetable oil. Washing methyl ester is a two-step process that is performed with great care. This process is continued until the methyl ester layer is clear. After settling, the aqueous solution is drained, and water alone can be added to 28% by volume of the final bath oil. The resulting biodiesel fuel, if used directly on a diesel engine, will burn up to 75% cleaner than D2fuel.

Crude Biodiesel Purification: Dry bath is an interesting method, to a lesser extent, as no water is required. Adsorbents such as Magnesol (a commercial adsorbent composed of amorphous magnesium silicate) or ion exchangers are used to eliminate water and other contaminants.

When using biodiesel and biodiesel / diesel blends, one can see a decrease in the efficiency of the engine power and the efficiency of the engine compared to the performance of using diesel fuel. This amount decreases with the increase in the amount of biodiesel in the mixture with diesel. A significant decrease was observed in B100 fuel in engine performance modes associated with high (so-called) active power and high operating torque (5-10%). When using a mixture of cottonseed biodiesel and diesel fuel in the same volumes, there was not a significant change in engine power, however, there was an increase in specific fuel consumption due to the difference in low thermal energy and high density and viscosity of B40 compared to diesel fuel. Low heat capacity, high viscosity, and congestion, followed by low dispersion and large oil droplets and low-quality composition, are all causes of a decrease in energy and efficiency and an increase in fuel consumption. Analysis of fuel injection characteristics indicates the start of the injection, the duration of the injection, and the increase in injection pressure, and the increase in the biodiesel content in the mixture with diesel fuel. However, it is possible to get the right injection time before active power, specific fuel consumption, gas discharge temperature, pressure on cylinders and other important aspects of engine performance are acceptable when using the pure biodiesel compared to diesel. If you use gasoline with a different mixture of biodiesel and diesel fuel, one can see a growing trend in the reduction of smoke with the increasing amount of biodiesel in the mixture.

4. SAMPLE GRAPHS

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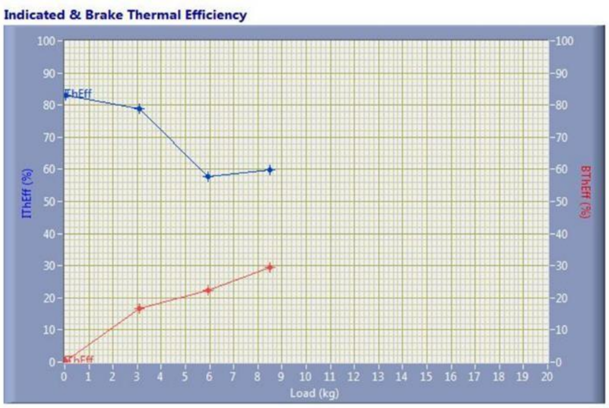

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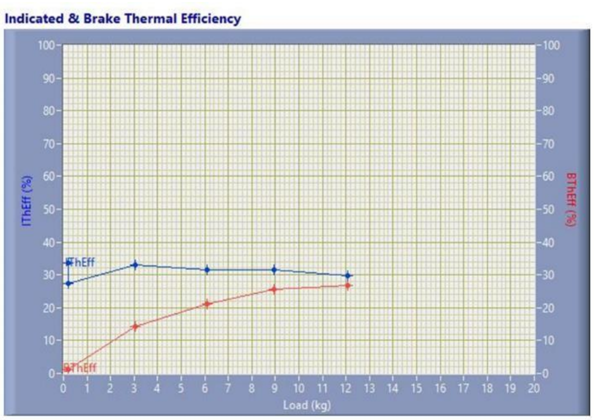

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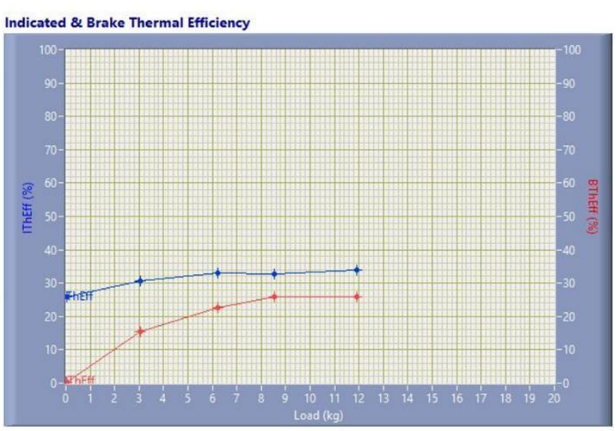

5. CONCLUSIONS

1. The brake thermal efficiency of biodiesel blends is higher than that of diesel at all load conditions.
2. It is concluded that the ideal value of compression ratio for blend must be 18 and the ideal blend to be considered is B40.
3. Biodiesel mixing with diesel improves most of the fuel properties and can be used as an alternative fuel for diesel engines.
4. They have lower emissions and high flash point (usually >300F), hence they are safer. They are biodegradable and essentially non-toxic.
5. Mass emissions of carbon monoxide and particulates found lower with Biodiesel blends, but NOx increased.
6. Other advantages of biodiesel include that its physical and chemical properties are very similar to petroleum-based diesel fuel in terms of operation.
7. Therefore, it can be used in diesel engines without expensive alterations to engine or fuel system. It is also biodegradable and free from sulphur and aromatics, making it safer to handle and transport. Biodiesel runs in any conventional, unmodified diesel engine.
8. Some research requires that to be intended to test diesel fuel mixture in DI engine vehicles under varying speeds and operating conditions.
9. Strong diesel emission conditions are to be expected soon, so a consistent drop in engine output with suitable post-combustion devices is required to assemble the appropriate fuel.
10. Finally, additional research activities are needed to find the right fuel combination from an environmental perspective.

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