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MAKING AND PREPARATION OF BIODIESEL - APPLICATIONS FOR SOXHLET OIL EXTRACTION AND TRANSESTERIFICATION PROCESS.

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Abstract:

Significant changes in environmental air pollution, is considered as the major concerns in recent days. Due to rapid increase in population, continuous running operations in industries, and need in agricultural operations demand for supply of fossil fuels increased. Fossil fuels are known as the primary source of fuels since the engine generate high efficiency, however due to the growing demand, scarcity in availability of the fuel, and increase in emissions are under contemplating issue. This concern made to look forward for a renewable source of fuel to increase the engine performance and reduce greenhouse gas effect. In this context, biodiesel is drawing wider attention nowadays, since it has the capacity to emit less emissions, biodegradable, improvement in the engine performance etc. In the present investigation, making and production of cotton seed biodiesel is proposed to estimate the oil obtained using Soxhlet extraction methods and further transesterification process is carried out to obtain biodiesel. The yield of cotton seed oil obtained was 60% The obtained biodiesel is blended with mineral diesel fuel the fuel thermal properties such as kinematic viscosity, flash point, fire point, calorific value is measured from our college research thermal laboratory. Finally, the biodiesel obtained and proves to be a sustainable green fuel to reduce the emissions.

Keywords: *Biodiesel, cotton seed oil, oil extraction, fuel properties*

1. Introduction

In recent days environmental pollution occurred due to transportation, industries and agricultural usage etc. are of major concern increasing the demand to search for alternative sources. Fossils fuels like mineral diesel are one of the reasons for the increasing in air pollution [1] as the increase in population, increase in usage of automobiles. There must be immediate necessity to reduce the pollution by introducing renewable sources of the fuels. The biodiesels are classified into first, second, third generations.

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The first- and second-generation biodiesels [1] are the edible (peanut, soy, corn, palm biodiesel etc.) and non-edible oils like castor, mahua, cotton seed oil, japtropha, pongamia and etc. Biodiesels are gaining wider

attention in reducing the environmental pollutions and reducing emissions. In this paper as an attempt, biodiesel fuel cotton seed oil is used as a source of fuel as this seed is abundantly available and can reduce the environmental pollution while using in transport sector. Initially the cotton seeds are crushed and using Soxhlet apparatus the oil is extracted. The obtained cotton seed oil (COSO) is further processed to convert the raw or crude cotton seed oil into cotton seed biodiesel by a popularly known method termed as transesterification process. This obtained biodiesel is tested for its fuel properties, to test the biodiesel suits to operate in diesel engine, which remains as a better source of alternative to reduce emissions and sustainable operations.

2. Biofuels

Biofuels are drawing increasing attention worldwide as substitutes for petroleum-derived transportation fuels to help address cost, energy security and global warming concerns associated with liquid fossil fuels. The term is used here to mean any liquid fuel made from plant material that can be used as a substitute for petroleum-derived fuel. Relatively recent popularized classification for liquid biofuels includes “first generation” and “second generation” fuels. First generation is generally derived from food crops like sugarcane soybean etc. The biochemical methods like fermentation or hydrolysis are employed to convert them to biofuels. Second generation is those fuels which generally produce from non-food crops. (Lignocelluloses biomass such as wood, forestry waste, organic waste etc). Biochemical or thermochemical methods are used to synthesis biofuels. Figure1, represents the biofuel as a renewable source of fuel.

Figure 1: Biofuels - Renewable source of fuel

3. Materials and Methods

3.1 Materials

The cotton seed are purchased from the agricultural farmers. The chemical solutions like n hexane, Sulphuric acid H_2SO_4, Methanol, Potassium Hydroxide KOH, were purchased from the Sigma Aldrich Chemicals. The heater and glass ware were used from our research thermal laboratory. Soxhlet apparatus for extraction of cotton seed oil was utilized from the Raghu Pharmacy College, Raghu educational Institutions.

3.2 Methods

3.2.1 Cotton Seed and oil Extraction:

Cotton seed is an important crop yields natural fiber, which is most famous for its usage in textile industry. The lint is removed from the cotton seed for the extraction of oil. It is second best producing potentials source after soya bean and best crop lists over nine [2,3]. The cotton pictorial representation is shown in the figure 2.

Oil extraction procedure:

The cotton seeds were dried in sunlight for 3 days during day hours and crushed using a coffee grinding machine [4]. The cotton seed powder is ready to load in Soxhlet apparatus figure 2, to extract oil. The oil extraction method requires n-hexane, round bottom flask, heater, reflux condenser, outlet pipes and inlet pipes, Soxhlet apparatus. A lab scale of 500 gms of cotton seed powder [4] is loaded in the Soxhlet apparatus and fixed with a reflux condenser. A round bottom flask filled with n-hexane and placed on the heater. The solvent and the dried cotton seed powder is mixed in the ratio of 1:2 (500 gms: 1000 ml) and heated for about 18 hours until the extract completely turns into pale color. After extraction using a steam distillation process, the cotton seed oil and the n-hexane are separated and the cotton seed oil is stored in a dark place covering with aluminum foil to remove the moist. Now after 8 hours collect the cotton seed oil in an airtight beaker and at the same time collect the n-hexane and this solvent can be reused for further extraction process. Repeat the experimental process until the powder is complete. Hence the finally obtained cotton seed oil is further processed for transesterification.

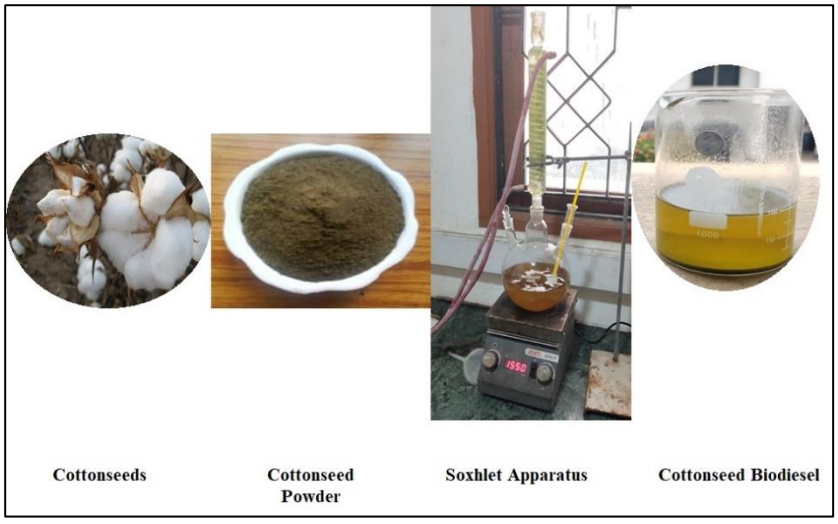

Figure 2: Cotton Seed and Oil Extraction Process

3.2.2 Biodiesel Transesterification

The obtained cotton seed oil (COSO) is not suitable to use directly in engine, for this the COSO must be converted to biodiesel. The reason is the kinematic viscosity is the influencing parameter to run on the engine. The range of the kinematic viscosity must be less than 6 mm^2/sec, for the raw cotton seed oil the kinematic

viscosity ranges from 28 to 32 mm^2/sec. Hence to reduce the viscosity of the oil for smooth operation, transesterification process is used to convert raw oil to biodiesel. Initially the transesterification process [5] consists of two treatments one is acid treatment and second one is base treatment. For acid treatment 10 drops of sulphuric acid and 110 ml of KOH are mixed and kept aside by closing with cork. Now heat the raw cotton seed oil until it reaches to 100 ºC, now cool down the solution and add the mixture of sulphuric acid and methanol and stir continuously for 4 hours by covering the flask with cork and cotton, so that methanol does not escape. Next after the acid treatment, base treatment is initiated by mixing methanol 100ml and KOH 7gms. Start heating and stirring the solution, for again 4 hours, now make the solution cool down, and the biodiesel and glycerol are separated. Pour in a separatory flask, and separate the glycerin. Now water wash the biodiesel with distilled water for 3 to 4 times and heat the obtained oil for 4 to 5 hours until the water droplets are evaporated. Now after cooling the solution, finally pure cotton seed biodiesel (COSBD) is formed. The complete process of transesterification is shown in the figure 3.

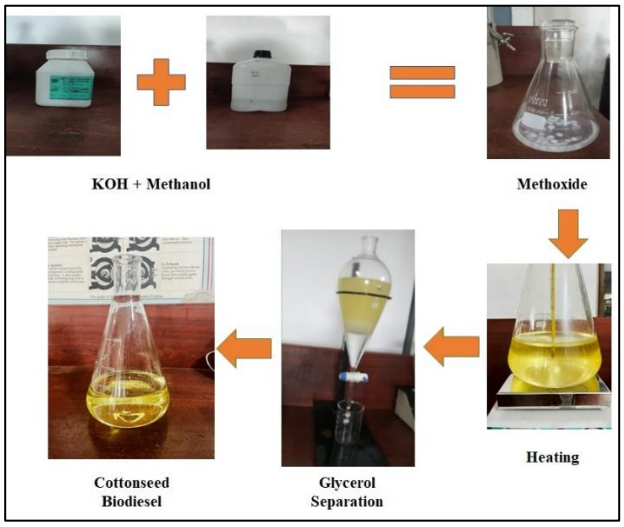

Figure 3: Transesterification process of Cotton Seed Biodiesel.

4. Results:

4.1 Yield Calculation:

After the cotton sed oil extraction, and performed several no of trails, for 5000 gms of cotton seed powder, the oil obtained is 3000 ml and the cotton seed oil yield obtained is 60%. The theoretical calculation was mention below.

- Solvent Used n hexane
- mixing = 1:2 ratio
- 500gm = 1000 ml hexane
- (cotton seed powder = n-hexane solvent)
- Aafter mixture of oil & n-hexane
- Extraction for 18 hours Cotton seed oil and n-hexane solvent are obtained.

- Now the mixture is separated using steam distillation method - n-hexane 90% can be recovered
- 5000/500 = 10 trails
- For 500 gms of powder 300 ml oil extracted x 10 trails
- 3000 ml of cotton seed oil is obtained
- yield =mass of oil extracted / total dried algae powder
- yield = 3000/5000 = 60%
- Yield of Cotton Seed Oil Obtained = 60%

4.2 Thermal Fuel Properties for Cotton Seed Biodiesel

After the cotton seed biodiesel oil is obtained, and the biodiesel oil [8] is blended with mineral diesel fuel of COSBD 10, COSBD 20, COSBD 30, COSBD 40 and tested in our college research center in thermal laboratory and estimated the fuel properties as per International standards ASTM, and EN Standards [9,10]. The definitions of the few fuel properties and table representing the fuel properties were listed in the below table 2.

Kinematic Viscosity: Kinematic viscosity is a measure of a fluid's internal resistance to flow under gravitational forces. It is determined by measuring the time in seconds, required for a fixed volume of fluid to flow a known distance by gravity through a capillary within a calibrated viscometer at a closely controlled temperature.

Flash Point: flash point, the lowest temperature at which a liquid (usually a petroleum product) will form a vapor in the air near its surface that will "flash," or briefly ignite, on exposure to an open flame. The flash point is a general indication of the flammability or combustibility of a liquid.

Fire Point: The fire point is the temperature to which the product must be heated under the prescribed conditions of the method to burn continuously when the mixture of vapor and air is ignited by a specified flame.

Table 2: Thermal Fuel Properties for cotton seed biodiesel [6-8]

Fuel Properties	Units	COSBD 10	COSBD 20	COSBD 30	COSBD 40
Kinematic Viscosity	(mm2/sec)	6.0	6.2	6.24	6.4
Density	kg/m3	858	861	862	864
Calorific Value	(kJ/kg)	38558	38600	38620	38629
Flash Point	(oC)	125	139	142	144
Fire Point	(oC)	131	145	150	152

5. Conclusions:

Cotton seed oil used in this paper is important as it available in our country and the seeds extracted using Soxhlet apparatus obtained better yield of 60% for 5000 gms of cotton seed powder. The oil is further converted to biodiesel by using two treatments and used KOH and Methanol as homogeneous catalyst. The yield obtained is in better agreement and achieved above 90% of the biodiesel yield. Then the biodiesel is prepared into various blends starting from COSBD10, COSBD20, COSBD30, COSBD40 and the thermal fuel properties were obtained and the values obtained were in good agreement with the international standards. By this it is reported that cotton seed biodiesel is suitable to run in engine experimentation to reduce the emissions and environmental pollutions.

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