Production of Biodiesel from Vegetable Oil

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Abstract— Biofuel from plant oils have pulled in an incredible consideration as substitutions for customary diesel to diminish dependence on fossil based-oil and offer an Eco-accommodating fuel. The transesterification response of cotton seed oil with isopropyl liquor utilizing potassium hydroxide as catalyst has been pondered for the generation of biodiesel. The target of this investigation is to locate the best condition for the generation of isopropyl esters of cottonseed oil. The response parameters utilized are isopropyl liquor/cottonseed oil molar proportion (6:1 up to 30:1 in interim of 3), catalyst amount (0.5–2.5 wt. %) and heating events of (50–80°C) while the term of the technique and the mixing force are fixed at 2 hour and 600 rpm, separately. However, about 98.9% of unsaturated fat isopropyl esters was gotten at the best states of 2h, 600 rpm, 1.5% catalyst concentration, 70ºC temperature of the response and 1:24 as cotton seed oil to isopropyl liquor molar proportion.

Key words: Biofuel, Transesterification, Microemulsions, Pyrolisis

I. Introduction

Today it is fundamental to utilize elective fuel due to energy security, ecological concerns and social-financial reasons. Expanding oil costs and consumption of oil stores require better options of vitality from petroleum products. With ascend in worry for contamination brought about by non-renewable energy sources, for example, oil, coal and gaseous petrol, elective fills and sustainable wellsprings of vitality, for example, biodiesel are coming in vogue. Bio fuels, fuels derived from biomass have been gaining the attention as of highly renewable, biodegradable and locally available. Biomass liquid fuels are Bio alcohols: ethanol is the most well-known, Biodiesel: acquired from vegetable oil or animals fats and Bio crude synthetic oil. Biofuels are carbon-neutral, nontoxic and reduce emission of volatile organic compounds. Bio-diesel is an alternative to petroleum-based fuels derived from vegetable oils, animal fats, and used cooking oil including triglycerides. Vegetable oils are broadly accessible from different sources, and the glycerides present in the oils can be considered as a practical option for diesel fuel. They have good heating power and provide exhaust gas with no Sulfur and aromatic polycyclic mixes. Vegetable oils are created from plants, burning leads to a complete recyclable carbon dioxide (CO_2). CO2 related with solar energy falling on earth gets changed over in to the feedstock through photosynthesis. Vegetable oils accessible through this feedstock can be utilized to create biodiesel. The utilization of vegetable oil for energy purposes is not new. It has been utilized world over as a wellspring of energy for lighting and heating since days of yore. As early as in 1900, a diesel-cycle motor was exhibited to run entirely on groundnut oil at the Paris work. Indeed, even the innovation of change of vegetable oil into biodiesel isn't new and is entrenched. The present accessibility of vegetable oils on the planet is all that anyone could need to meet the edible oil necessities, and surplus amount accessible can in part meet requirement of biodiesel generation. However, there is a significant potential to further improve the oilseeds generation on the planet to fulfill the expanding need for sustenance and biodiesel.

II. Vegetable oils

Vegetable oils or vegetable fats, will be fats extricated from seeds or less regularly, from different pieces of natural products. Like animal fats, vegetable fats are blends of triglycerides. Soybean oil, rapeseed oil, and cocoa spread are instances of fats from seeds. Olive oil, palm oil, and rice wheat oil are case of fats from different pieces of natural products. In like manner utilization, vegetable oil may allude solely to vegetable fats which are liquid at room temperature.

A. Vegetable Oil Production

There are two sorts of procedures for the creation of vegetable oils. One is mechanical while the other is chemical. The method is picked relying upon the utilized harvest. In the mechanical method the oil is removed by squeezing of oil seeds and oleaginous organic product. In the chemical method, solvents are utilized for concentrate the oil.

B. Vegetable Oil as an Alternate Ci Engine Fuel

The vegetable oils, animal fats, and their subordinates, for example, alkyl esters are appropriate as diesel fuel on the grounds that there must be some closeness to petro diesel fuel or if nothing else to a portion of its segments. The fuel property that best demonstrates this reasonableness is known as the cetane number. In addition to ignition quality as expressed by the cetane scale, a few different properties are significant for deciding the reasonableness of biodiesel as a fuel. Heat of combustion, pour point, cloud point, (kinematic) viscosity, is among the most significant of these properties. These vegetable oils make up a huge division of overall consumable oil generation. All are additionally utilized as fuel oils.

III. Biodiesel

Biodiesel is an elective fuel planned only for diesel motors. It is produced using vegetable oil or animal fats or it is the name for an assortment of ester based energizes commonly characterized as the mono alkyl esters produced using vegetable oils through basic transesterification process. It has higher oxygen content than oil diesel and its utilization in diesel motors have indicated extraordinary decreases in discharge of particulate issue, carbon monoxide, sulfur, polyaromatics, hydrocarbons, smoke and noise. Furthermore, consuming of vegetable oil based fuel does not add to net climatic CO2 levels in light of the fact that such fuel is produced using agricultural materials which are created by means of photosynthetic carbon obsession.

A. Fuel Properties of Biodiesel

1) Density
2) Kinematic Viscosity
3) Flash Point and Fire Point
4) Water content or Moisture content
5) FFA content
6) Calorific value

B. Comparison of Biodiesel and Petroleum Diesel

As appeared in Table 1, biodiesel and petroleum diesel have comparative viscosities .The combustion enthalpy of biodiesel is marginally lower, however its cetane number is higher as is its flash point.

C. Emissions

The majority of the emissions created by fossil fuels are higher than those produced by biodiesel.

Methyl ester of Oil	Kinematic viscosity	Cetane number	Thermal power	Melting point	Flash point	Density
	(·10^6m²/s)		(MJ/L)		(°C)	(kg/L)
Babassu	3.6	63	31.8	4	129	879
Corn used	6.2	63.	42.3		166	884
Diesel	2.8	58	42.7		59	833
Olive	5.7	62	33.5	13	164	880
Peanut	4.9	54	33.6	5	176	883
Rapeseed	9.5	53	36.7		192	895
Soybean	4.5	44	33.5	1	178	885
Sunflower	4.6	49	33.5	1	183	860

Table 1: Physicochemical Properties of Biodiesel

Biodiesel does not create SO_2 emissions, its combustion is increasingly successful on account of its higher oxygen content and particulate issue and CO emissions are lower as shown in Table 2. Emissions of hydrocarbon compounds are additionally diminished by biodiesel, however NOx become higher. Biodiesel produces 4.7% more CO_2 than oil diesel, yet the majority of it is captured by plants during the development arrange, and therefore its commitment to the greenhouse effect is negligible. Biodiesel additionally has better greasing up properties, extending motor life and diminishing noise level. Since it has great solvent properties, the engine funneling is kept clean from cinder. The disadvantage is that normal rubber sleeves(still utilized in old motors) are broken up by biodiesel, but this can be effectively maintained a strategic distance from, as these parts are made today of engineered rubber.

D. Work in engines

Biodiesel indicates comparable thermal effectiveness to diesel fuel, however has higher fuel consumption, because of its lower energy content. exhaust gas temperature is regularly lower than for diesel, which means that the ignition of biodiesel starts earlier and has a more extended extension period. The start of fuel infusion happens prior in biodiesel than with diesel fuel, because of their diverse physico-synthetic properties. The start defer period is also shorter on account of biodiesel.

E. Toxicity

The high octane number of the oxygenated compounds present in biodiesel does not require the addition of antiknock mixes. Therefore, emissions got from polycyclic fragrant hydrocarbons (PAHs) and their nitro derivatives(NAPH's) are decreased. PAHs are decreased by 85 %,except benzo-antracen which is just diminished by half. Likewise, NAPH's (2-nitrofluorene and 1-nitropyrene) are radically decreased by 90 % (Sharp, 1998).

F. Biodegradability

Tests done by University of Idaho have shown that degradation of biodiesel in an aqueous solution was 95 % in 28 days, a period which is similar to that of sugar. For a similar period of time, only 40 % of oil diesel was degraded. Petroleum diesel is made out of a blend of alkenes, spread alkenes, cycloalkenes and aromatic hydrocarbons.

Emission (kg/100 km)	Biodiesel 100%	Biodiesel 30%	Diesel
CO	0.37	0.43	0.46
Hydrocarbons	0.07	0.04	0.04
NOx	2.73	3.37	3.64
Particulate matter	0.63	1.48	1.85
CO_2	0.87	3.53	4.67
SO_2	0	1.14	1.62

Table 2: Examination between Emission Levels of Biodiesel (Pure or Mixed) and Fossil Fuel in Automotive Engines

A wide scope of micro-organisms can be degrading alkenes, yet aromatic compounds are increasingly hard to degrade. Also, since oil diesel contains less oxygen than biodiesel, it is less biologically active. It has been shown that mixture of biodiesel and oil diesel accelerates biodegradability. The pace of biodegradation of aB20 blend (20% of biodiesel and 80% of fossil fuel) is twice that of the petroleum derivative.

IV. BIODIESEL PRODUCTION PROCESSES

Three sorts of procedures have been concentrated to create biodiesel from vegetable oils and waste cooking oils, to be specific Pyrolisis, emulsification, and transesterification.

A. Pyrolisis

It consists of the application of thermal energy in the presence of air or oxygen, to produce a chemical modification. The thermal decomposition of triglycerides yields alkanes,alkenes, alkadienes, aromatic compounds and carboxylic acids. As a result of the wide assortment of response pathways, diverse response items are gotten.

Regardless of the way that items are synthetically like oil diesel, oxygen expulsion during thermal cracking a portion of the ecological advantages of these inexhaustible oils.

B. Microemulsions

It has been prepared with solvents such as methanol, ethanol and 1-butanolin order to lower the high viscosity of biodiesel. These micro emulsions are isotropic, clear, and are thermodynamically stable dispersions of oil, water and a surfactant; a cosurfactant is often dispersed, using amphiphilic compounds. This process yields fuel with lower viscosity, but injection in the engines is not so efficient, and a coarse deposition and incomplete combustion is generated.

C. Transesterification Process

The transesterification procedure, purported alcoholysis, is the dislodging of a alcohol in the ester particle by another alcohol as in a hydrolysis response, utilizing alcohol rather than water. Appropriate alcohols are methanol, ethanol, propanol, butanol and amyl liquor. Methanol is the most normally utilized, as a result of its ease and great physicochemical properties. Transesterification of oils, subsequently decreases the consistency of triglycerides, and furthermore improves the physical properties of the last item (cetane number, infusion proficiency), bringing about a superior fuel. Unsaturated fat methyl esters acquired by transesterification can be utilized legitimately, and with comparative energy productivity as petroleum diesel.

D. Acid Transesterification

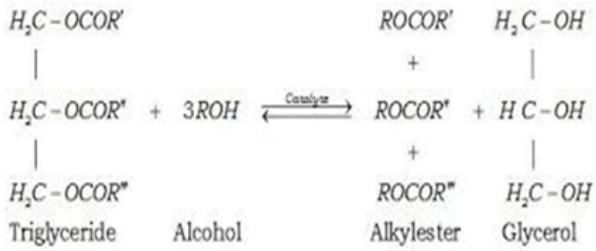
Transesterification of triglycerides is catalyzed by inorganic acids, for example, sulphuric, phosphoric, hydrochloric, and sulphonated natural acids. This catalytic procedure creates high transformations, at a slow rate, and over multi day to arrive at complete conversion is required. An abundance of alcohol increases the change, yet makes glycerol recovery increasingly muddled. Subsequently, advancement is required to locate the best relationship between alcohol and the crude material. This procedure is, however, the most suitable for triglycerides with a high substance in free unsaturated fats and water. Acid-catalyzed transesterification begins by mixing the oil legitimately with the acidified alcohol, so that division and transesterification happen in a single step, with the alcohol acting both as solvent and as esterification reagent. Sunflower oil transesterification with acidified methanol yields fatty corrosive methyl esters with higher change to that got in the basic procedure.

The proposed response system comprises of the protonation of the carbonyl oxygen bunch by the acid that, within the sight of a alcohol, generates the comparing unsaturated fat ester. Response energy is regularly expected to follow a pseudo-first request model, when an alcohol excess is available to move the equilibrium.In-situ transesterifications, where the simultaneous extraction of nonpartisan lipids and bran is created, have also been proposed for soybean oil.

E. Alkali-catalyzed transesterification

Alternative catalysts for triglycerides transesterification to biodiesel area unit alkaline hydroxides, like metallic elements and potassium hydroxide. Responses of methanol or ethanol with various vegetable oils, rough or refined or even waste cooking oils have been performed utilizing hydroxides as catalyst.

At present, the industrial biodiesel synthesis is being dole out these alkaline catalysts, since reaction rates area units much higher (even 4000 times) than for acid chemical action. Better efficiencies area unit obtained if the alcoxyde is formed before transesterification. The reaction mechanism has three main steps. The first step involves an attack on the ester by the alcoxyde ion, to form a tetrahedrical intermediate. The reaction between this intermediate with an alcohol molecule generates an alcoxyde in the second step. In the last step, ester and diglycerides are produced. The response proceeds in a comparable path with the diglyceride and themonoglyceride, freeing three ester particles and glycerol.



V. MATERIALS AND METHODOLOGY

A. Materials

The refined cotton seed oil was used. The business diesel fuel was bought from petroleum siphon. All chemicals (Methanol, KOH Catalyst) are used. Magnetic separator and titration setup used for transesterification of cotton seed oil was used in process. The fuel properties have been determined by using equipment's such as Redwood viscometer, open cup flash and fire apparatus.

B. Process of Transesterification

1) Weigh 4gm of Potassium Hydroxide (KOH) flakes on a weighing scale.
2) Take 50ml of Methanol in measuring cylinder.
3) Mix 4gm of KOH and 50ml of Methanol into 125ml of conical flask and add a magnetic stir bar.
4) Mix the contents within the flask over a magnetic stirring plate until the entire solid KOH is dissolved.
5) Take 200ml of vegetable oil [cottonseed oil] into 250ml conical flask.
6) Boil the vegetable oil upto 50°C to 55°C [below the boiling point of methanol].
7) After the desired temperature is reached mix the vegetable oil and potassium methoxide and keep it on magnetic stir plate for mixing. Let the solution be mixed for 10 minutes.
8) After 10 minutes placed the flask contents into a separatory funnel and allow the solution to separate at room temperature for an additional 60 minutes.
9) After 60 minutes remove the lower glycerol layer into 50 ml flask.
10) The upper layer is fatty acid methyl ester [FAME] that is biodiesel.

11) Weigh the separated biodiesel and note down in observation table.

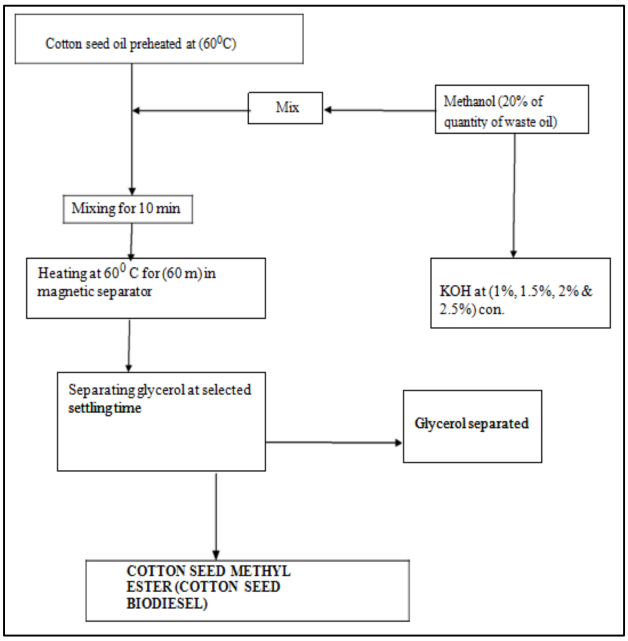


Fig. 1: Steps involved in the methyl transesterification of cotton seed oil

Fig. 2: Vegetable Oil and Potassium Methoxide

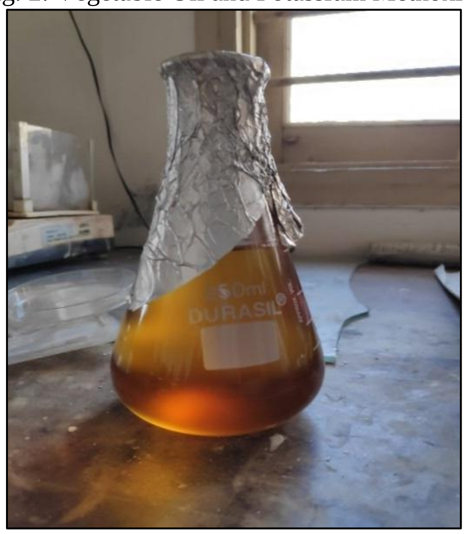


Fig. 3: Solution of Vegetable oil and Potassium Methoxide

Figure 4:- Layer formation of biodiesel and Glycerol in separating funnel.

VI. RESULT AND CALCULATIONS

A. Result

- Weight of empty flask = 122.64 gm
- Weight of flask after separating = 312.21 gm
- Weight of Biodiesel = 312.21 – 122.64 = 189.57 gm

B. Calculations

THEORETICAL:

Weight of Biodiesel

$$=\frac{200\ ml\ VO}{1}*\frac{1.015\ gm\ VO}{1\ ml\ VO}*\frac{1\ mole\ VO}{877\ gm\ VO}*\frac{3\ mole\ BD}{1\ mole\ VO}*\frac{292.2\ gm\ BD}{1\ mole\ BD}$$

$$=\frac{200*1.015*3*292.2}{877}$$

= 202.907 gm of Biodiesel.

$$\text{Yield percentage} = \frac{\textit{Actual weight of biodiesel}}{\textit{theoretical weight of biodiesel}} * 100$$

$$=\frac{189.57\ gm}{202.907\ gm}*100$$

= 93.42 %

VII. CONCLUSIONS

The experiment yielded 93.42 % of the available biodiesel product. Viscosity test of the product revealed that the biodiesel was less viscous than the vegetable oil.

The synergist adjustment of vegetable oils is a promising technique to get a substitute fuel for diesel motors. Among different kinds of adjustment, the transesterification procedure is increasingly prudent, simpler and quicker, creating a steady item which can be utilized straightforwardly in current motors. Transesterification yield is often better when employing a basic catalyst, like sodium methoxyde, although acid catalysis might give better results, provided that free fatty acid content is high. Both methanol and ethanol can be utilized as esterifying operators, being methanol the frequently utilized these days. By the by, the utilization of ethanol would create a completely inexhaustible and all the more ecologically well-disposed fuel. In the transesterification process, reaction variables such as water and free fatty acid content ought to be deliberately controlled to arrive at significant returns, thus should the sort of catalyst.

Response parameters are firmly impacted by the sort of oil utilized, and a case to case advancement is required.

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