A Review on Different Methods used for the Production of Biodiesel

Anil R. Mali[1], Deepmala. I. Desai[2]
[1, 2] Department of Applied Science
[1, 2] SSBT COET, Bambhori, Jalgaon

Abstract- *Many investigators carried out worked on produce energy from different alternative sources with solar and biological sources such as the conversion of trapped energy from sunlight to electricity and conversion of some renewable agricultural products to fuel. This review paper considers the use of different oil for the production of alternative renewable and environmental friendly biodiesel fuel as an alternative to conventional diesel fuel. Biodiesel is gaining more and more significance as an attractive fuel due to the depleting fossil fuel resources.*

Keywords- Rice bran oil, Jatropha caucus oil, Waste Cooking Oil, Transesterification, castor oil, Thumba oil, Coconut Oil, biodiesel.

I. INTRODUCTION

With the increasing use of diesel fuel, many initiatives have become more attractive to search for alternate fuels to supply or replace fossil fuels. Biodiesel is synthesized from edible, non-edible and waste cooking oil or animal oil or vegetable oil can be regarded as an alternative diesel fuel. [9] Biodiesel is an oily liquid synthesized from fatty material. It has a light yellow color and mild odor and a bitter taste, The process used to convert these oils to Biodiesel is called transesterification. In the present day it is very essential to use alternative fuel because of energy security, environmental concerns and socio-economic reasons. The present review summarizes the methods carried out on production of biodiesel.

II. PRODUCTION OF BIODIESEL

Subhan Kumar Mohanty study on A Production of biodiesel from rice bran oil and experimenting on small capacity diesel engine.[1]In the present work, the transesterification process is carried outRice bran oil is an underutilized non-edible vegetable oil, which is available in large quantities in rice cultivating countries.rice bran oil was converted into methyl ester by the two stage process.In the stage first rice bran oil was reacted with CH3OH in presence of an acid catalyst (H2SO4) to convert free fatty acid into fatty ester. A specified amount 1000g of rice bran oil was taken in a round bottom flask and heated up to 60-65°C. In a separate flask CH3OH (950 g) and H2SO4 (22 g) were taken and properly mixed and then stirred for 4 h and maintained at 60°C.It was allowed to cool overnight without stirring. When acid number of the mixture reaches to less than 1,the second stage was started .During this stage mixture 1000g obtained from the first stage was taken in around bottom flask and heated upto 60°C methanol(200ml) and KOH 4.5g were properly mixed in other flask and then introduced into the round bottom flask containing the mixture from first stage. The mixture stirred vigorously for 2h and then allowed to cool overnight. Glycerol was separated by adding warm water at 60°C to the mixture. Glycerol and soap formed during the process settled down the bottom. Top layer containing rice bran oil methyl ester 91% was removed with the help of a separating funnel and wasted two times with water and dried.

Highina et.al .carried out Biodiesel production from Jatropha caucus oil in abatch reactor using zinc oxide as catalyst.[2]The transesterification reaction of Jatropha oil was carried out by using zinc oxide as a catalyst. 2.0 g (2.5 ml) of methanol was measured and poured into a test tube after which 0.09114 g of ZnO pellet was carefully added to the test tube. complete dissolution of ZnO pellet in the methanol. 9.115 g (10 ml) of (Jatropha caucus oil) JCO was measured out, pre-heated to 65°C in a three-necked flat bottom flask with reflux condenser using a water bath and thermometer to observe the temperature.The pre-heated JCO is poured in a 250 ml beaker placed on a magnetic stirrer. The prepared zinc methoxide from the test tube was carefully poured into the JCO. Then the beaker was secured tightly using a stopper and the magnetic stirrer switched on and moderate agitation in the beaker was maintained for 25 min. The mixture was poured from the beaker into a second test tube for settling and the top secured using cork. The reaction mixture was allowed to stand overnight while phase separation occurred by gravity settling into golden/pale liquid biodiesel on the top with the light brown glycerol at the bottom of the test tube. The JCO biodiesel was carefully decanted into a plastic test tube leaving the glycerol at the based. The biodiesel was washed with water.The procedure was repeated by varying parameters controlling the transesterification reaction. In each case

biodiesel yield as well as glycerol yield was measured and recorded.

Sharma et. al. carried out Production of Bio-Diesel from Waste Cooking Oil.[3]This experiment has been performed to evaluate performance of mechanical stirring method of bio-diesel production.Waste cooking oil (8 kg) is filtered and then heated to 65oC and kept at this temp for about 05 min to remove impurities and moisture. Methyl alcohol (CH3OH) is taken with a molar ratio of (1:4.5 & 1:6) and Catalyst (KOH) is taken as (0.75% and 1% by wt of oil).The mixture of methyl alcohol and KOH is stirred until KOH dissolve in methyl alcohol. Now the Waste cooking oils (WCO) and mixture of methanol and catalyst are put together into the Beaker and mechanical stirring is applied. The methanol is immiscible with the oil. A magnetic capsule is dipped in the mixture of oil, methanol and catalyst and rotated with the help of magnetic stirrer and mechanical stirring is applied for about10 minutes -30 minutes and more. During the reaction the temperature of mixture is kept in between 60-650C. While reaction taking place five samples are drawn each of 100 gm at a time interval of 35 min, 50 min, 65 min, 80 min and 95 min. Separation of methyl ester and glycerol will take 8 to 12 hr duration. After complete separation bio-diesel (methyl Ester) is visible in the upper layer and glycerol at the bottom. Excess methanol present in bio-diesel has been removed by vaporization process. Bio-diesel is then separated from beaker for purification process and water washed. To remove impurities and catalyst, water at around 40-50 0C is mixed with the methyl ester and left for settling down. Excess water is removed by heating the bio-diesel up to 1000C.

Bharadwaj et.al. studied on Production of Biodiesel (Biofuel) from Algae.[4]The experiment was carried out in the Analitika Ecolab , Gwalior , Madhya Pradesh, India.Collection of Two sets of eight Petri dishes Algae (4of Spirogyra sp.And4 of Oedogonium 25 g) were made , which were collected from the Tigra Water Dam in Gwalior , India. Oil extraction: Algae were ground with motor andpestle as much as possible. The ground algae were dried for 30 min at 80°C in a incubator for releasing water. Solvent like : Hexane and ether solution (25 and 25 mL) were mixed with the two-two sets of dried ground algae of both the species to extract oil. Then the mixture was kept for 24 h for settling.The biomass was collected after filtration and weighted.Mixing of catalyst and methanol: 0.25 g NaOH and 0.25 g KOH were mixed with 24 mL methanol in 2-2 different sets of Oedogonium and Spirogyra sp. to analyze their respective yields of biodiesel andwere stirred properly for 20-25 min.The mixture of catalyst and methanol was poured into the algal oil in a conical flask.The reaction process is calledtrans-esterification. The conical flask containing solution was shaken for 3 h by electric shaker at 300rpm.After shaking the solution was kept for 16h to settle the biodiesel and sediment layers clearly. The biodiesel was separated from sedimentation by flask separator carefully.

Thirumarimurugan et al. Preparation of Biodiesel from Sunflower Oil by transesterification. [5]This process is carried out to determine the amount of Potassium hydroxide that would be required. This process is the most crucial and the most important stage of Bio- Diesel manufacturing Titration method for determining how much catalyst needed to neutralize the fatty acids in the used vegetable oil. Dissolve 1 gram of KOH in 1 liter of distilled water and Dissolve 1 ml of waste vegetable oil into 10ml isopropyl alcohol. set the pH of between 8-9 by adding NaOH one milliliter at a time. You will see an eventual rise in the ph level. Record the quantity of KOH solution added until the color of the oil changes pink and holds for at least 5 seconds (This represents a pH of between 8 and 9).Preparation of Potassium Methoxide, Carefully pour the KOH solution into 100 ml methanol. Agitate the mixture until the KOH is completely dissolved in the methanol. The potassium methoxide solution prepared is mixed with oil. The residue is heated in between 120 oF to 1300F after which it is mixed well using a stirrer at 300 rpm. Continue mixing the contents. Carefully pour the potassium methoxide and shake vigorously for 15 minutes. After mixing the liquid, it is allowed to cool down. After the cooling process, the bio fuel is found floating on the top while the heavier glycerine is found at the bottom. The glycerine is easily separated by allowing it to drain out from the bottom. In this way pure Bio Diesel is prepared.

Karnwal et. al. studied on Production of Biodiesel from Thumba Oil: Optimization of Process Parameters. [6]Transesterification is acatalyzed (KOH/NaOH) chemical reaction involving oil/fat (triglyceride) and an alcohol (methanol/ethanol) to yieldfatty acid alkyl esters (biodiesel) and glycerol as abyproduct. All the chemicals and reagents used in thestudy were purchased from local market in Delhi and Thumba oil was procured from Udaipur, Rajasthan. Acid number of Thumba oil was determined as perASTM D664 and was found to be 0.8. Since FFA contentwas less than 1%, base catalyzed reaction was selected for biodiesel production. The experimental setup included 250 ml glass three necked batch reactor equipped with a reflux condenser, amechanical stirrer and a thermometer, immersed in aconstant-temperature bath. 100 g Thumba oil was taken inthe reactor and placed in the water bath at the desiredtemperature. Different weight percentage of Methanol and Potassium Hydroxide (KOH) were mixed and addedto oil in the reactor at the prefixed temperature. Afterthe required time, mixture was transferred to a separatingfunnel, allowing glycerol to separate by gravity

forovernight. After removing the glycerol layer, washingof methyl ester was done with lukewarm water toremove catalyst, methanol and glycerol residuals. Theraw biodiesel after successive washing was heated to100°C in an open vessel to remove any water particles.

Soliman et.al.carried out Production and characterization of biodiesel fuels from castor oil utilizing methanol. [7]Potassium hydroxide was added to methanol in a mixer and stirred for 10 to 15 minutes until it is completely dissolved. It was then mixed with the castor oil in a reactor equipped with a heater, magnetic stirred at 70oC.Stirring was continued and the product was placed in aseparating funnel and left over night for glycerin to settleto the bottom of the funnel and then removed in ameasuring cylinder. The impure methyl ester (biofuel) was washed with Sulfuric acid (98% concentration) anddistilled water, prior to drying in the furnace at 150 °C fortwo hours. To ensure pure biofuel is obtained, NuclearMagnetic Resonance test (NMR) was carried out. experimental set up including Magnetic stirringhot plate, Magnetic stirring bar, Crucible (1000 ml), Funnel separator (1000 ml), Beaker (2000 ml), Graduated cylinder (250ml), Chemical scales, Thermometer (0:100ºC), Chemical equipment holder, Stopwatch, Furnace, and Condensing system.The results obtained by converting castor oil intomethyl ester using different amounts of castor oil, withmethanol as a reagent, and potassium hydroxide as catalyst at different times of reaction.

Transesterification

Castoroil + Methanol ⟶ Glycerin + Biodiesel

Oguntola J ALAMU et. al. discussed about Production and Testing of Coconut Oil Biodiesel Fuel and its Blend. [8]Transesterification Process: Coconut oil like any other vegetable oils and animal fats are triglycerides, inherently containing glycerine. The biodiesel process (transesterification) turns the oils into esters, separating out the glycerine from the main product (biodiesel). The glycerine sinks to the bottom and the biodiesel floats on top and can be decanted off. The process is called transesterification, which substitutes alcohol for the glycerine in a chemical reaction, using acatalyst.In the Laboratory scale production of coconut oil biodiesel, the following materials were used; 1 litre of coconut oil, 200 ml of ethanol 99+% pure, potassium hydroxide (KOH),blender, scales accurate to 0.1 grams, measuring beakers for ethanol and oil, translucentplastic container with bung and screw-on cap, funnels, bottle for settling and washing, ducttape and thermometer. The major feedstock source used in this work is coconut oil, locally produced in Nigeria. It was purchased at the local market in Ayetoro, Ogun State, Nigeria. By the stoichiometric equation of the process, 1 mol of coconut oil is required to react with 3 molesof ethanol to produce 3 moles of the biodiesel and 1 mole of glycerol.

III. CONCLUSION

The overall review has concluded that production of biodiesel using different methods is important because biodiesel protect the environmental pollution. Many researchers have carried out study on production of biodiesel. Biodiesel is an alternative diesel fuel important from economical and environmental point of view. So that more new technologies could be applied for production of biodiesel. The current review summarizes biodiesel which has similar properties to diesel and can be used to fuel an existing unmodified diesel engine without any difficulty.

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