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Review Article

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Production methods of biodiesel

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ABSTRACT

The alternative fuel should be found to compensate the future fuel demand and reduce the pollution. The vegetable oil/animal fat has a high energy density to meet the energy compensation, but its properties are not favorable for better atomization so can be converted in to biodiesel. Generally four methods are used to produce biodiesel from vegetable oils and animal fat. The biodiesel production methods such as direct use and blending, transesterification process, pyrolysis and micro emulsion. The aim of the paper is to make a clear review of biodiesel production methods

Key words: Biodiesel, Direct use and blending, transesterification, pyrolysis, microemulsion.

INTRODUCTION

The biodiesel is nothing but the mono alkali ester which is derived from the animal fat or vegetable oil. The carbon will be neutral when biodiesel is used as a fuel, because during the combustion process, the amount of carbon emission is equal to an animal or plant absorbed during it whole life time. So the emission will be low in green combustion of biofuel.

In current situation the diesel is a most domination fuel in the world including the area of transport, agriculture, and power generation, some industrial applications, etc. To make a long term energy security the alternative should be found. The vegetable oil can be the alternative for diesel and it could be the fuel in the diesel engine [1]. By 2015 the biofuel can contribute 27% of total fuel need which will reduce the emission of CO_2 nearly 2.1 Gt per year [2].

I. DIRECT USE AND BLENDING

The animal fat or vegetable oil can be used as a fuel in direct injection engines; it has a good heating value and could give a sufficient power. But it has some problems due to its unacceptable properties, so it cannot be used in DI engine without any modification. To avoid such problems the alternative fuel sources are directly blended with conventional fossil fuels. This kind of blending will improve the fuel quality, reduces the fossil fuel consumption, etc., so it is also preferable as a most convenient way to use an alternative fuels such as biofuels. The bio oil and diesel blends will be in different ratio like 10:1,10:2, 10:3, etc.,[3-5].

II. TRANSESTERIFICATION PROCESS

The transesterification process is a reaction between triglycerides in the vegetable and alcohol which produces the biodiesel (mono alkali ester) and glycerol [6].

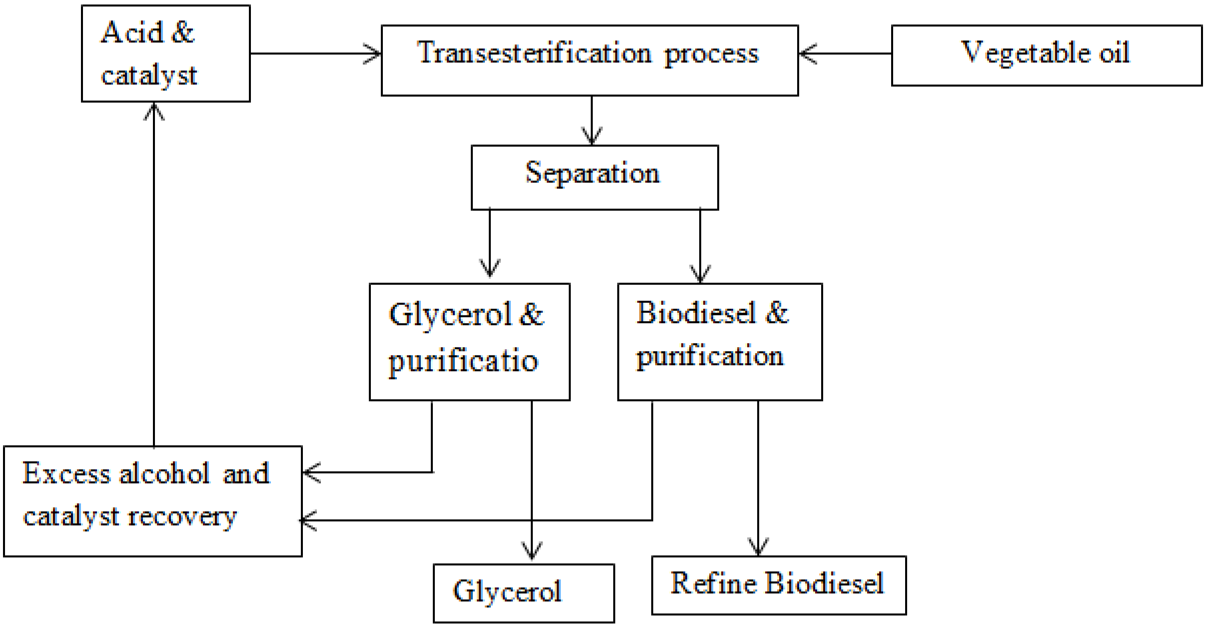

Fig 1. Transesterification process

In this process some catalyst also used to increase the speed of the reaction and quality of the outcome product. The amount and types of catalyst are decided by the amount of free fatty acid present in the feed stock oil. The higher amount of free fatty acid is unfavorable for biodiesel production which leads to formation of soap and biodiesel yield efficiency [7-8]. The figure 1 shows that the biodiesel production process.

Base catalyst transesterification process

In this stage of process potassium Hydroxide (KOH), sodium hydroxide (NaOH) and sodium methoxide are used as a catalyst. The sodium methoxide is most efficient catalyst but it is not economic. It is a reaction between alcohol and oil with the presence of base catalyst [9]. The reaction temperature (50^0C – 60^0C) should also be maintained in order to get highest biodiesel yield. The reaction temperature should be below of methanol boiling point. Otherwise methanol is wasted due to vaporization. The stirring process (1300 rpm) is carried throughout the process for dynamic mixing to increase the rate of reaction. Nearly one hour it will take place to complete the reaction. By the above reaction the biodiesel and glycerol produced it should be separate so the solution should place in a separating stock for 12 hours to 24 hours. The upper layer is biodiesel and the lower will be the glycerol [10-12].

Acid catalyst esterification process

Some feed stock oil has more than 1% free fatty acid; this free fatty oil cannot be converted into biodiesel. So the yield of biodiesel from the transesterification process will be very low. In this case the feed stock oil is involved to the acid catalyst esterification before the base catalyst transesterification process. Here the free fatty acid is converted into the ester [13]. This process also can used to convert the triglycerides into the biodiesel but it will take more time so it is not preferable [14]. In this process the alcohol will reacts with oil using acid catalyst and produces the biodiesel and water, the water must be removed immediately because the water will leads to the formation of soap while in base catalyst transesterification process. Here phosphoric acid or sulphuric acid is used as a catalyst. The product obtained from acid catalyst is use to produce biodiesel through base case catalyst transesterification process [15-17].

III. THERMAL CRACKING (PYROLYSIS)

Thermal cracking is a process of convert the complex structure of hydrocarbons into its simplest structure with or without catalyst. Due to this process the density and viscosity of oil will reduce. In vegetable oil as an alternative fuel this two properties are affecting the atomization of engine.

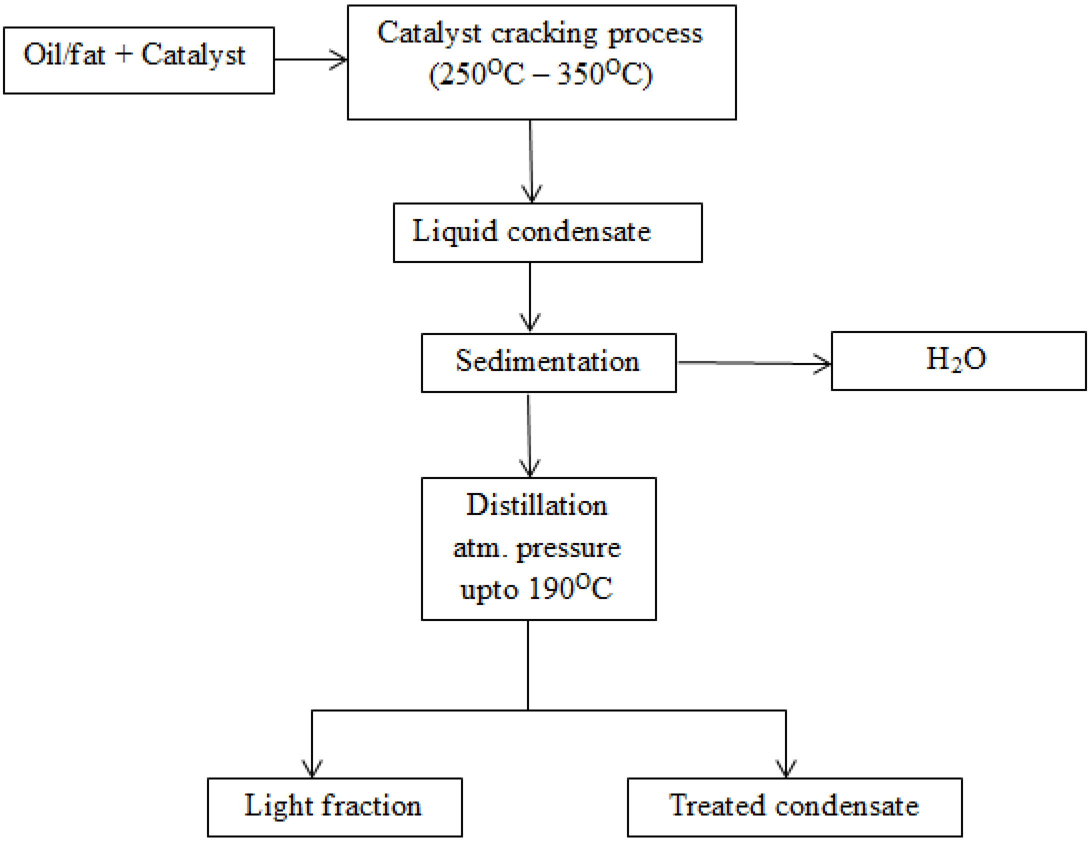

Fig 2. Thermal cracking process

So the fuel treated by this process which could be use directly in diesel engine without any modification. Generally alumina, zeolite and redmud are used as a catalyst in thermal cracking process for biodiesel production [18]. The thermal cracking process will happens by the temperature between 250^{O}C and 350^{O}C. the thermal cracking biodiesel plant has a reactor with safety valve, drain pipe, temperature indicator, etc., the oil or animal fat need to be convert into the biodiesel is placed inside the reactor, then heat is applied to the reactor. Now the oil or animal fat get vaporized and reach the condenser through pipe. The condenser cools the vapor in the liquid then the liquid is collected in the beaker which is called as biodiesel [19-21]. The fig2. shows the process flow of biodiesel production using thermal cracking process.

IV. MICROEMULSION

The micro emulsion is defined as thermodynamically stable, isotropic liquid mixtures of oil, water and surfactant (compounds that lower the surface tension of a liquid, the interfacial tension between two liquids).; this process will solve the problem in viscosity and some other atomization properties of oil [22-23]. Generally the alcohol used to increase the volatile property of oil, it reduces the smoke. Alkyl nitrate will be the cetane number improver. The microemulsion process also used to get a good spry property when injected into the engine by nozzle. If micro-emulsified diesel used in diesel engine, some problems will arise such as incomplete combustion, carbon deposit and nozzle failure [18, 24].

CONCLUSION

Some factors should be consider in the production of biodiesel such as cost, property, production methodology, required equipment, etc., the transesterification process will give a better fuel quality and yield efficiency, it also does not require any complicated special equipment. The glycerol will obtain as a bi product of a process. It can be used for some other required applications which will reduce the overall production cost. Because of the above reasons the transesterification process can be the better biodiesel production process than others.

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