
PRODUCTION OF BIODIESEL FROM NON- EDIBLE OIL (WCO)

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ABSTRACT

Today world's energy demands are increasing day by day due to increase in population, standard of living, industrialization & urbanization and which are mostly fulfilled by fossil fuels. Fossil fuels are non-renewable so its reserves are getting declined and also it is environmentally unreasonable. This made an interest in the area of alternative fuels. Biodiesel can be good alternative fuel because of its renewability and environmental benefits and apart from this it can be a strategic source of energy for the countries which doesn't have oilfields. Biodiesel can be produced from edible, non-edible, algae and waste cooking oils. There are four primary ways to make biodiesel, direct use and blending, micro-emulsions, thermal cracking (pyrolysis) and Transesterification. The most commonly used method is transesterification of vegetable oils and animal fats. This investigates the transesterification reaction of refined vegetable oils by means of ethanol, using sodium methoxide and sodium hydroxide as catalysts. Particularly, the objective of this work was to prepare ethyl esters with the two different homogeneous catalysts, while the reaction had been carried out in one step. Afterwards, the resulting products were evaluated regarding the physicochemical properties.

Keywords: Biodiesel, non-edible oil feedstocks, biodiesel production processes, catalytic transesterification, factors affecting yield, properties of biodiesel.

INTRODUCTION

The worldwide worry about the protection of environment and the conservation of non-renewable natural resources, has given rise to alternate development of sources of energy as substitute for traditional fossil fuels. The major part of all energy consumed worldwide comes from fossil sources (petroleum, coal and natural gas). Alternative new and renewable fuels have the potential to solve many of the current social problems and concerns, from air pollution and global warming to other environmental improvements and sustainability issues. Manufacturing of Biodiesel from *waste cooking oil* which is also a non-edible oil which is beneficial for environment

BIODIESEL

Biodiesel is an alternative fuel similar to conventional or 'fossil' diesel. Biodiesel can be produced from straight vegetable oil, animal oil/fats, tallow and waste cooking oil. The process used to convert these oils to Biodiesel is called Transesterification. In the present work a set of experiments was carried out for producing ethyl esters under homogeneous catalyst with sodium methoxide. Waste cooking oil was intentionally utilized to avoid the side reaction of neutralization of free fatty acids. All tests were performed with sodium methoxide (CH₃ONa) as homogeneous catalyst. The purity of biodiesel was assessed by ester content. The mass yield was determined as an indicator of the purification of biodiesel, showing that the less soaps and emulsions led to less loss. Assessment of ethyl esters needs further consideration because the reaction system is very sensitive to minor changes in the experimental conditions degrading the FAME quality.

ROLE AND IMPORTANCE OF BIODIESEL

The role of Biodiesel industry is not to replace petroleum diesel, but to help create a balanced energy policy with the most benefit .It is one of several alternative fuels designed to extend the usefulness of petroleum, and the longevity and cleanliness of diesel engines. The ultimate goal is to contribute to building a stronger, more self-sufficient community by way of a community-based biodiesel production model. The great advantage of biodiesel is that it can be used in existing engines, vehicles and infrastructure with practically no changes. It can be pumped, stored and burned just like petroleum diesel fuel, can be used pure, or in blends with petroleum diesel fuel in any proportion. This can also be used as heating fuel in domestic and commercial boilers. The power output of biodiesel depends on its blend, quality, and load conditions under the fuel is burnt.

WASTE COOKING OIL

Waste Cooking oil used for frying are sunflower oil, palm oil, coconut oil etc. As they are easily available and especially so of the coconut oil which is abundantly available in South India. The waste cooking oil samples used for the purpose is of usually palm oil because it is commonly used oil in the restaurants and hostel kitchens.

MATERIALS AND METHODS

Transesterification Process

Transesterification can be defined as a chemical reaction in which alcohol reacts with triglycerides of fatty acids(vegetable oil), in presence of catalyst. It is a reversible reaction. It is used mainly in the synthesis of polyesters and in the production of biodiesel because it has more advantages than ester synthesis from carboxylic acids and alcohol.

There are mainly types of transesterification process based on the use of catalyst and those are:-

1. Base-Catalyzed Transesterification
2. Acid-Catalyzed Transesterification

Flow sheet of Biodiesel from non edible oil

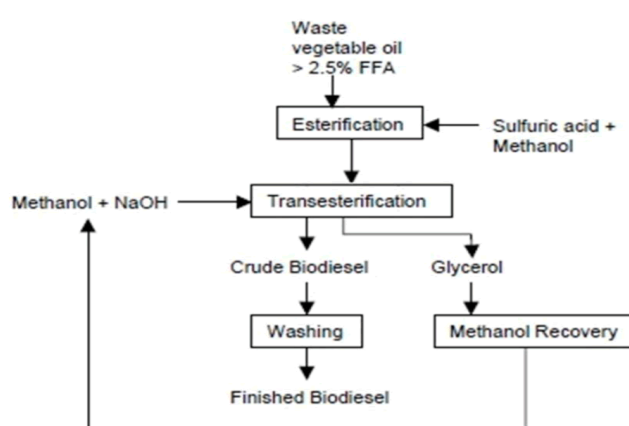


Figure 2: Flow Chart of Making of Biodiesel

Production of Biodiesel From Non Edible Oil

Biodiesel is made by a chemical process called transesterification, where organically derived oils (vegetable oils, animal fats and recycled restaurant greases) are combined with alcohol and chemically altered to form fatty esters such as methyl ester. The biomass-derived esters can be blended with conventional diesel fuel or used as a neat fuel (100% biodiesel). The process results in two products -- methyl esters (biodiesel) and glycerin .

PROCEDURE

The catalyst used was sodium methoxide CH₃ONa obtained from. Ethanol was of 99.9% purity (water content: 1000 mg/kg), and it was used as the transesterification alcohol. Pure glycerol was also used in order to accelerate the separation of ester-phase and glycerol-phase. The transesterification reaction was carried out in a flat-bottomed spherical reactor, provided with mechanical stirring, sampling outlet, and vapor refluxing system. The agitation speed was chosen at 300 rpm so as to avoid the mass transfer limitations, and the reaction time was prolonged for 8-9 hours. Catalyst concentrations examined were 0.7% m/m for CH₃ONa, as an optimal concentration for refined oils and for NaOH initially the same concentration of 0.7% m/m but afterwards, 0.4% m/m was tested further. Subsequently, the raw reaction mixture was cooled down to laboratory temperature and then, it was transferred to a separating funnel. Glycerol was added in amount 10% of the reaction volume into the funnel and it was stirred vigorously for 3 minutes. Thereafter, the settlement lasted for four hours. After the separation of the two layers by gravity, the co-product glycerol was carefully withdrawn; the ethyl esters were washed several times with warm distilled water (60 °C), in order to extract the residues of catalyst. Eventually, the non-reacted alcohol and water were removed by rotary evaporator at reduced pressure. For small scale production of biodiesel 250 ml oil, 63.8 ml methanol and 4.565 gm. sodium methoxide is taken.

3.3. Physio- Chemical Properties

- Density
- Flash Point
- Fire Point
- Viscosity
- Cloud Point
- Cetane Number

RESULT AND DISCUSSION

Reacting Conditions:-The experiments were carried out in steady environmental conditions, at ambient pressure, at 80 °C and in one-stage transesterification process, by ethanol refluxing. The experimental variables were the catalyst CH₃ONa and the ratio of ethanol to oil, that was in the range of 6:1 – 15:1. The concentration of CH₃ONa catalyst was stable of 0.7% m/m. The first tests of 0.7% m/m CH₃ONa in waste oil showed satisfactory conversion at molar ratios of 9:1 – 12:1.

Effects of CH₃ONa

A set of experiments was carried out with CH₃ONa as ethanolysis catalyst. In contrast to hydroxides, the reaction of CH₃ONa with ethanol doesn't liberate water but methanol, so, the absence of water prevents from hydrolysis reactions in the system. As evidenced, the ester content. The higher molar ratios of ethanol to oil are more beneficial for complete conversion.

CH₃ONa was consumed in a slower rate and in a smaller extent, amounting to 28%. Phase separation after reaction, in case of methoxides, was fast and no soapy interfaces or emulsions were formed. The final mass was lower for CH₃ONa, explaining the less soaps and emulsions.

Ethanol to Oil Molar Ratio

It is an important parameter examined in this work is the molar ratio of ethanol to oil. The results shown in Figure 1 confirmed the need for the optimum molar ratio. It showed that the best ethanol to oil ratio for FAME production was 12:1. The optimized molar ratio of ethanol to oil was 12:1.

Mass basis yield

On the basis of the mass yield results, the transesterification reaction with CH₃ONa was better than with NaOH or KOH on a mass basis of recovered ethyl esters. The mass difference between the function of the catalysts was caused by the higher amount of soaps formed with NaOH. For comparison, a design of two-stages process in the presence of 0,7% m/m CH₃ONa was further tested. The results revealed that there was an improvement in ester content, although its value is satisfactory at 12:1 molar ratio, but the major gain of the multistage process were: easier separation and purification stages, less emulsions and soaps formation, resulting to higher ethyl esters mass yield because the losses were reduce.

CONCLUSION

In an attempt to produce biodiesel with more sustainable characteristics, ethanol was used as transesterification alcohol. CH₃ONa showed satisfactory ester yield and better recovery, since the methanol solution supplied did not contain the hydroxide group to hydroxides, hindering the triglycerides saponification and ethyl esters decomposition. Hence, the ethanolysis of refined waste cooking was efficiently carried out under 0.7% m/m CH₃ONa at ambient pressure and 80 °C.

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