

Comparative Study of Biodiesel Produced from Waste Chicken Fat and used Cooking Oil

Nimisha.k¹, Harsha.P²

¹M.Tech Student, Dept. of Civil Engineering, KMCT College of Engineering for women, Kerala, India

²Asst.Professor, Dept. of Civil Engineering, KMCT College of Engineering for women, Kerala, India

Abstract - An environmental friendly bio refinery process for producing biodiesel from chicken waste and used cooking oil were conducted in this study. Low acid value chicken oil obtained from chicken waste. Diesel engine led to emission of harmful gases such as carbon monoxide, Sulphur oxides etc. This will effect harm on health and increase global warming. Thus with advanced knowledge and developing technologies to control pollution caused by diesel engines use of biodiesel can be an alternative to other fossil fuels. Biofuels can be produced from variety of sources such as vegetable oils and animal fats. In this study inedible chicken fat and used cooking oil are used as a source for biodiesel production. Its use in diesel engines shows great reduction in emission of particulate matter and noise. Trans esterification is one among the various processes through which bio diesel is produced in presence of acid base or bio catalysts. Alkaly catalyzed trans esterification is considered to be the best amongst all methods available for the prevention of biodiesel.

Keywords: Biodiesel, Esterification, acid catalyst, Base catalyst, Tri glycerides, Fatty acid methyl ester

1. INTRODUCTION

In recent years, the cost of petroleum products has remained consistently high. Biodiesel is an alternate source of energy for petroleum diesel. As we know petroleum products are highly effecting our environment because of its harmful substitutes and the emission at the time of combustion[13]. Carbon Monoxide emission from petroleum diesel is a major concern, to avoid the emission of Carbon Monoxide, new technologies have arised to produce an ecofriendly fuel in place of petroleum products[4]. Thus the products of biodiesel has arised. The sources for biodiesel are mainly animal fats and vegetable oils. Oil from waste animal fats which are not edible can replace vegetable oil and thus can reduce the cost of production. Along with reducing the expenditure using waste animal fat as raw material it helps to reduce the waste to an extent[8]. By using it efficiently biodiesel also helps the environment in recycling Carbon dioxide in short periods. There are many methods among those trans

esterification process using animal fats or vegetable oils is a very efficient method for biodiesel production with the addition of suitable catalysts. Therefore, an alternative fuel supply for petroleum products will be a welcomed resource to help reduce the expenditures[7]. Biodiesel can be used as a fuel or mixed with petroleum-based diesel. The advantages of biodiesel are present in its nontoxic nature, highly biodegradable nature, and very less chemical emission characteristics. Biodiesel can be produced by the transesterification process of triglycerides (from animal fats or vegetable oils) and alcohol with the assistance of a suitable catalyst.

1.1 Objectives of the study

Biodiesel is an alternative diesel fuel derived from vegetable oils or animal fats. The disposal of Waste cooking oil can be problematic when disposed irresponsibly. Any fatty acid sources may be used to produce biodiesel. The use of edible vegetable oils and animal fats for biodiesel production has recently been of great concern because they compete with food material- the food versus fuel dispute. Reusing of these waste oils and fats not only reduce the burden of the government in disposing the waste, maintaining public sewers, and treating the oily waste water, but also lower the production cost of biodiesel significantly.

- I. To produce an environment friendly fuel to replace fossil fuels thus can reduce environmental pollution considerably.
- II. To produce an economically viable fuel, Thus countries having low economic status can also afford fuel as much as possible.
- III. To reduce atmospheric pollution and support human life in a better way.
- IV. To reduce the wear and tear of diesel engine, thus maintenance cost will be less.
- V. To produce a sustainable and ecofriendly fuel that could substitute the fossil fuels.
- VI. To prove chicken fat and used cooking oil are one of the raw materials in biodiesel production.

2. METHODOLOGY

2.1 Solid Waste Collection and Extraction of Oil

Chicken waste for producing the raw material chicken oil is collected from nearby chicken stall at Kakkodi. Used cooking oil is collected from Famous restaurant at Kakkodi. From the chicken stall and restaurant came to know that disposal of these two waste products are a serious concern as they will lead to severe environmental pollution. Thus this kind of projects are very much acceptable all over the world. Extraction of oil is done by two process, Boiling process and Gravity separation process. The oil boiling need heat energy, gravity separation is a very slow process .After the oil extraction the raw oil is converted to Biodiesel.

2. Two Stage esterification Process

Pre-esterification is a process for reducing the free fatty acid content of fats and oils by esterifying the free fatty acids with a lower mono alcohol in the presence of an acidic cation exchange resin as a solid esterification catalyst. Acid catalysts are too slow to be suitable for converting triglycerides to biodiesel. However, they appear to be quite effective at converting Free fatty acids to esters. Because of these reasons, an acid catalyst can be used to esterify the Free fatty acid to esters[12]. The acid catalyzed process is called as pretreatment are converted to monoesters through the pretreatment of the feedstock with high Free fatty acid and thereby the Free fatty acid level reduces. The major handicap for the acid-catalyzed esterification of Free fatty acid is the water formation. Trans-esterification is the process of converting vegetable or animal fats and oils in to fatty acid methyl esters (biodiesel) in presence of an alcohol and an alkali. Methanol is used as an alcohol and KOH(Potassium Hydroxide) is used as an alkali. We took 500g of purified fat with 1Wt% of KOH and 1:6 oil to methanol molar ratio in a round bottom flask kept in a magnetic stirrer with hot plate at 60°C for about1 hr 30 min,1500 rpm[13].After the process the mixture is allowed to cool down for an hr. The mixture poured in a separating funnel kept it for 12 hrs. The Finally, the top layer as biodiesel and the bottom layer as glycerol.

3.RESULTS AND DISCUSSION

Biodiesel is prepared from both waste chicken oil and waste cooking oil. Free fatty acid present in both

have reduced considerably from 11% to 2.13% for chicken oil biodiesel, from 3.14% for waste cooking oil biodiesel. Biodiesel from waste chicken fat is more efficient compared to the product obtained from used cooking oil

Table -1: Biodiesel yield at different temperature and molar ratio

Time (Minutes)	Biodiesel yield (%)	Catalyst concentration (% weight)	Biodiesel yield (%)
70	84	0.75	87
80	76	1	90
90	86	1.25	82
100	88	1.5	72
120	90	1.75	78

Table - 2: Properties of Biodiesel

Properties	AST M D6751	Straight diesel	Chicken oil biodiesel	Used cooking oil biodiesel Method
Kinematic viscosity	1.9 - 6	3.18	4.56	4.43
Acid value	0.24	.2 - .6	4.76	5.83
FFA as oleic acid	Less than 1	0.24	2.13	3.14
Density (Kg/m ³)	860 - 900	839	885	860
Cloud point	Less than 2°C	3°C	10°C	9°C

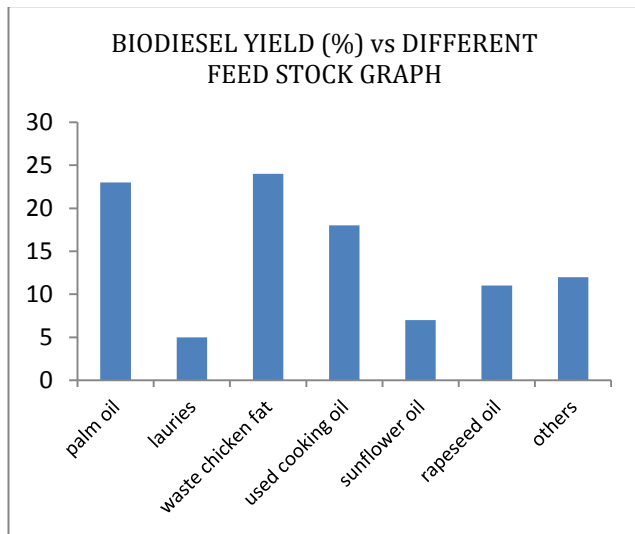


Chart 1: Biodiesel Yield of Different Feed Stocks

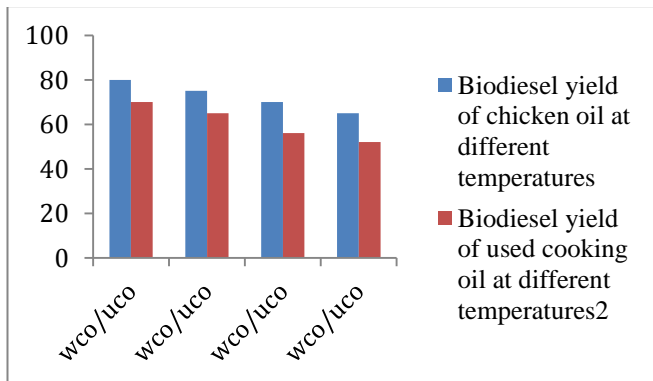
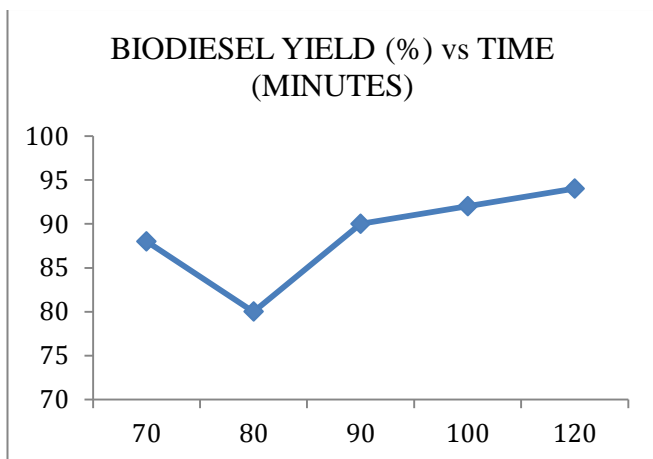


Chart 2 :Biodiesel yield vs Temperature



Graph 3: Biodiesel yield vs Time

Through this biodiesel production it has been proved that through pre esterification it is able to reduce the production of soap during the process by reducing free fatty acid content. The feed stock with low free fatty acid content is very much suitable for producing biodiesel through base catalyzed process. Among the catalysts it has been found that potassium hydroxide

is more efficient in resulting high yield than sodium hydroxide. For pre esterification acid catalysts are suitable, here I have used sulphuric acid as acid catalyst. From the above results it is clear that from both the feed stocks, chicken oil which is extracted from waste chicken fat is providing more yield than used cooking oil with same molar to methanol molar ratio, catalyst percentages, temperature and time. They create severe health issues to the human life if it is disposed in a careless manner.



Fig -1: Soap production during pre esterification



Figure 3 -: Chicken oil biodiesel

The above figures 1 & 2 give how soap is produced during pre esterification and which has to be reduced for biodiesel production and the produced biodiesel from chicken oil which has to be purified to get the final product to separate glycerol from it.

CONCLUSIONS

Biodiesel has attracted extensive attention in the world as it is a renewable, biodegradable, nontoxic and environmentally friendly new

alternative transportation fuel. It can be made from different feedstock containing fatty acids such as animal fats, nonedible oils, waste cooking oils, by products of the refining vegetables oils and algae etc. Transesterification process is a commonly employed for its formation. Cost of biodiesel can be reduced by using waste chicken fat and used cooking oil as feed stocks. High fatty acid content in both waste chicken oil and used cooking oil can be reduced by pre-treating oil with acid catalyst. Water produced during the esterification process may inhibit acid catalyst. Methanol is the most suitable alcohol because of its low cost and easy separation from biofuel. From all the results obtained it has proved that the biodiesel produced from waste chicken fat is more efficient than that produced from used cooking oil, as an esterification catalyst Potassium Hydroxide is more efficient than Sodium Hydroxide. Both the feed stocks are a major concern in terms of waste disposal, thus this project helps the nature in both ways by converting waste products like waste chicken fat and used cooking oil to a useful products like biodiesel. the project also helps to reduce environmental pollution caused by the combustion of fossil fuels by replacing it with a nature friendly biodiesel, considerably.

ACKNOWLEDGEMENT

The authors would like to thank Mr. Shanmugasundaram sankar (2016) Nehru College of Engineering and research centre, pampady thrissur.

REFERENCES

- [1] Alptekin, Ertan., Canakci, Mustafa., Sanli, Huseyin (2014). Biodiesel Production from Vegetable Oil and Waste Animal Fats in A Pilot Plant, Waste Management; volume 34, pages :2146-2154.
- [2] Ayhan Demirbas (2009), Biodiesel from waste cooking oil via bas catalytic and supercritical methanol transesterification, Energy conservation and management ,volume 50, pages 923 - 927.
- [3] Adeyinka Sikire Yusuff, John Olusoji Owolabi (2019), Synthesis and characterization of alumina supported coconut chaff catalyst for biodiesel production from waste frying oil, South African journal of chemical engineering, volume 30 ,pages 42 - 49.
- [4] Anildo Cumba Jo , Vivial feddern et al (2013) , Synthesis and characterization of ethyl biodiesel from animal fat waste. Fuel volume 105, pages 228 - 234.
- [5] Astuti E, Supranto, Rochmadi, Prasetya A (2014) Kinetic modeling of nitration of glycerol: three controlling reactions model. Engineering Journal, volume 18(3), pages 73-82.
- [6] Astuti E, Supranto, Rochmadi, Prasetya A (2016). Optimum operating conditions of glycerol nitration to produce 1, 3-dinitroglycerin. ARPN Journal of Engineering and Applied Sciences, volume 11(8) ,pages:5203 - 5208.
- [7] A.Purandaradas, T.Silambarasan et al (2018) , Development and quantification of biodiesel production from chicken feather meal as a cost effective feed stock by using green technology, Biochemistry and Biophysics , volume 14, pages 133 - 139.
- [8] Budiman, Mufrodi Z, Rochmadi , Sutijan Budiman (2014) Synthesis Acetylation of Glycerol Using Batch Reactor and Continuous Reactive Distillation Column. Engineering Journal, volume 18(2), pages 29-39.
- [9] Banerjee, Nabanita., Ramakrishnan, Ritica., Jash, Tushar (2014) . Biodiesel Production from Used Vegetable Oil Collected from Shoppes Selling Fritters in Kolkata, Energy Procedia, volume 54, pages 161-165.
- [10] Encinar, J.M, Gonzales, J.F, Rodriguez-Renairez, A, (2005). Biodiesel from Used Frying Oil, Variables Affecting the Yields and Characteristic of the Biodiesel, Ind Eng Chem , volume 44 ,pages 5491-9.
- [11] Ehsan Md., Chowdury MdTH (2015) , Production of biodiesel using alkaline based catalysts from waste cooking oil: a case study. Procedia Engineering, volume 105, pages 638-645 .
- [12] Gregory Hope Sogiatoro , Jeslyn Chang et al (2019) , home made ecogreen biodiesel from chicken fat and waste cooking oil, Energy procedia , volume 158, pages 1105 - 1109.
- [13] Shanmugasundaram sankar (2016) , Production of biodiesel from chicken fat, pork fat and combination of both feed stocks Nehru College of Engineering and research centre , pampady thrissur .