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Production of Biodiesel from Waste Materials

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ABSTRACT

The aim of this paper is to study the different processes of production of biodiesel from waste materials. Now a day the use of conventional fuels is increasing and these fuels are known for major cause of air pollution by the emission of carbon dioxide, particulate matter, sulfur dioxide and other harmful gasses. On the other hand the sources of conventional fuels are very less and the price of conventional fuel is increasing day by day hence to minimize all these study resulting in alternative methods for the production of biodiesel. The study conclude that the biodiesel can be obtain from waste cooking oil and waste plastic by the process of transesterification and pyrolysis respectively. The process of transesterification is to convert the oils and fats into biodiesel with the help of different catalysts such as KOH and NaOH. The pyrolysis process is breaking of hydrocarbon chain of plastic into hydrocarbon chain of petroleum product by heating on high temperature of about 300°C in the absence of oxygen.

Key words: Fuels, waste cooking oil, plastic, transesterification and pyrolysis.

INTRODUCTION

Our society is highly depending on petroleum but it is a finite source and causes several environmental problems. A demand for energy is increasing due to which research is directed towards alternative renewable fuels. Biodiesel is an alternative fuel made from renewable biological sources such as vegetable oil (both edible and non edible oil) , animal fats and waste product i.e. plastic. Biodiesel is produce from used vegetable frying oil and this is a by-product from hotels, restaurants and shop selling fritters. Practically the high viscosity of vegetable oils has 30-200 centistokes as compared to that diesel which is 5.8-6.4 centistokes. Transesterification is the most commonly used method to convert vegetable oil into biodiesel. In this method an ester compound is exchanged by an alcohol in the alkyl group. Biodiesel produce from waste cooking oil can minimize the cost of biodiesel production since the feed stokes cost constitutes approximately 70-95% of overall cost of biodiesel production.

Waste plastic are the most promising resources for fuel production since the use of plastic is increasing tremendously and nearly 200-300 years is required for its decomposed. Nearly 300 320 tonnes of plastic waste is generated throughout the year and its disposal is a major problem. Pyrolysis is the method use for producing biodiesel from waste plastic. In this method plastic is heated at a high temperature of about 300°C. In this process the polythene chain breaks into hydrocarbon chain of petroleum product.

MATERIAL USED

Waste Cooking Oil

The waste cooking oil obtain from different hotels after frying the food is collected and used for the process of

transesterification for the production of biodiesel.

Waste plastic

The plastic is very harmful for the environment as it takes about 200-300 years for its decomposition and open burning cause's air pollution. Hence waste plastic is used for the process of pyrolysis to obtain biodiesel.

METHODS:

There are two methods used for the production of biodiesel for different waste materials such as plastic and waste cooking oil. The methods used for the production of biodiesel are as follows:

1. Transesterification process
2. Pyrolysis process

TRANSESTERIFICATION

The Transesterification process is used for the production of biodiesel from waste cooking oil with the help of catalyst KOH or NaOH in the presence of alcohol. In this process the waste cooking oil (WCO) is first filtrated by using filter paper or cotton cloth so that the larger particles get removed from oil. Then the filtered WCO is preheated at a temperature of 50°C for about 15 to 20 minutes so that the moisture contained in the oil is evaporated. The preheating is depends upon the oil is fresh or used. The titration of WCO is to be done to find how much amount of KOH is required for the reaction as well as amount of KOH required to neutralize the FFA_s. For 1lit of oil sample, mix calculated amount of KOH by titration with 200 ml of methanol and stir it till KOH is completely mix with methanol. Now add the mixture of KOH to the filtrated oil sample and stir it at least for 20 min, the temperature of oil rises. Now close the container and leave it for 20 to 24 hours so that biodiesel separates from glycerol. The upper layer is biodiesel and lower layer is glycerol separate the biodiesel from glycerol. After this process of separation wash the biodiesel with water so that un-reacted alcohol gets removed from biodiesel hence obtained the pure form of biodiesel.

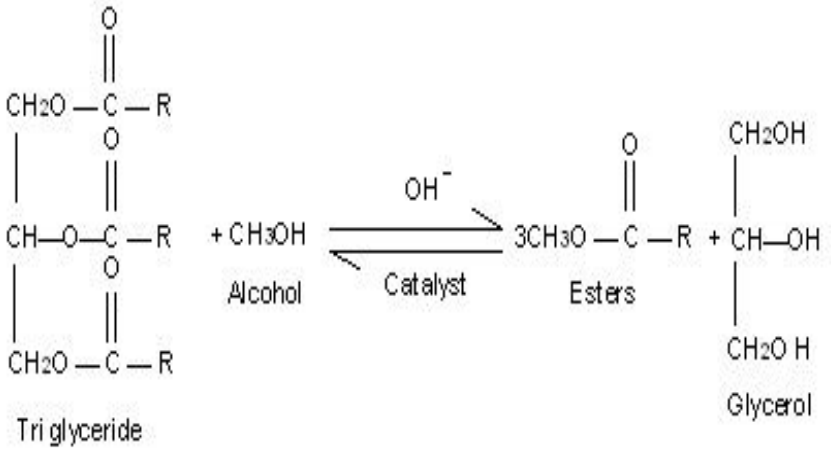

Fig.1. *The products of Transesterification reaction.*

Fig. 2. *Separated biodiesel from glycerol.*

PYROLYSIS PROCESS

The pyrolysis is the process used for the production of biodiesel from waste plastic by heating at high temperature for an about 300°C. In this process the polythene chain breaks into hydrocarbon chain of petroleum product. Take a jar (preferably steel) which is capable of sustaining fire at high temperature about 300°C. Put the plastic and tyre pieces inside this jar. Fix a small steel pipe in the hole. Take another jar (plastic one) for making a temporary condenser. Using the copper coil, bend it into condenser by twisting it into a coil like structure. Make sure a small portion of the coil inside the plastic jar comes out of a hole made in front of the jar. Place a glass or plastic beaker by the side of this plastic jar, making sure that the diesel coming from the coil will be stored in it. Now, this mechanism is ready to be placed on fire, burn the material inside the hearth and let this system be undisturbed for 20-30 minutes. After 30 minutes, the diesel coming out of the coil will be observed.

Fig.3. *Waste plastic used for process of Pyrolysis.*

Fig.4*. Waste tyre used for process of Pyrolysis*

Fig.5*. Homemade setup of Pyrolysis process.*

COST ANALYSIS

Frying Oil as a Waste

Table 1: *Cost analysis frying oil as a waste.*

Fuels	**Cost**		
Petrol	82		
Diesel	67		
Biodiesel	**Material**	**Quantity**	**Cost**
	Oil	500ml	25
	KoH	4gm	5
	Methanol	100 ml	7
	Other charges	-	10
	Total cost	47 Rs.	

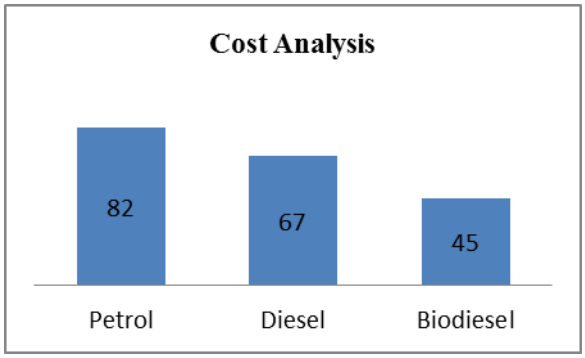

Fig.6: *Cost analysis, frying oil as a waste.*

Plastic as a Waste

Table 2: *Cost analysis frying oil as a waste.*

Fuels	**Cost**		
Petrol	82		
Diesel	67		
Biodiesel	**Material**	**Quantity**	**Cost**
	Plasitc	500 gm	--
	Tyre	400 gm	10
	Wood	5 kg	20
	Other charges	-	15
	Total cost	45 Rs.	

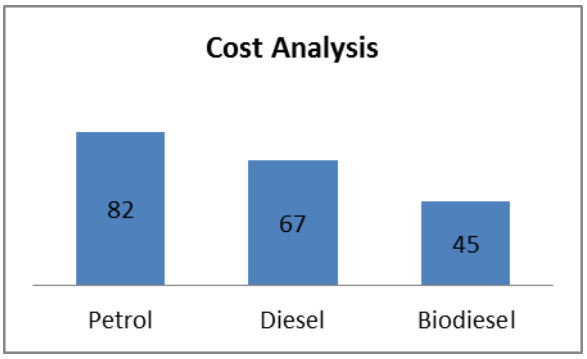

Fig.7. *Cost analysis, plastic as a waste.*

RESULT

S.No.	Property	Readings
1.	Flash point	160°C
2.	Fire point	180 ° C
3.	Density	0.8834 kg/ml
4.	Viscosity	36.5 Mm^2/s
5.	Cloud point	8°C
6.	Pour point	6°C

CONCLUSIONS

- Biodiesel is an effective alternative fuel for conventional diesel and can be directly used as fuel in a diesel engine without any modifications to the engine.
- A petroleum based fuel has been produced from waste plastic (polythene).
- The properties of the plastic oil and its chemical composition have been examined and conclude that average chemical formula was found to be $C_{13.18}H_{23.56}$, and hence the performance analysis was done in a CI engine.
- From the experimentation it has conclude that the bio diesel used in the engine for analysis, the lower blend % oil has a good efficacy.
- The results also conclude that in case of used of cheap catalyst the production cost decreases and in combined gaseous & solid the cost gets down.

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