World Academy of Science, Engineering and Technology
International Journal of Chemical and Molecular Engineering
Vol:5, No:7, 2011

Biodiesel Production from Waste Chicken Fat based Sources

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***Abstract*—**Chicken fat was employed as a feedstock for producing of biodiesel by trasesterification reaction with methanol and alkali catalyst (KOH). In this study chicken fat biodiesel with 1.4% free fatty acid, methanol and various amount of potassium hydroxide for 2 hour were studied. The progression of reaction and conversion of triglycerides to methyl ester were checked by IR spectrum method.

Keywords**—**Alkali catalyst, biodiesel, chicken fat, transesterification reaction

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I. INTRODUCTION

RECENTLY, because of a rapid increase of the price of petro diesel biodiesel is most widely accepted alternative fuel due to environmental advantages.

Production biodiesel from other inexpensive feedstock may significantly reduce the cost of biodiesel [1].

Demand for energy and its resources, is increasing every day due to the rapid outgrowth of population and urbanization. As the major conventional energy resources like coal, petroleum and natural gas are at the verge of getting extinct [1]. Biodiesel production is a very modern and technological area for researchers due to the relevance that it is winning everyday because of the increase in the petroleum price and the environmental advantages [2]. Biodiesel, an alternative diesel fuel, is made from renewable biological sources such as vegetable oils and animal fats. It is biodegradable and nontoxic, has low emission profiles and so is environmentally beneficial [3].

A. . The Production of Biodiesel

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 [3].

B. Transesterification

Transesterification or alcoholysis is the displacement of alcohol from an ester by another in a process similar to hydrolysis, except than alcohol is used instead of water [6]. This process has been widely used to reduce the high viscosity of triglycerides. If methanol is used in this process it is called methanolysis. Methanolysis of triglyceride is represented in Fig.1; Transesterification is one of the reversible reactions and proceeds essentially by mixing the reactants. However, the presence of a catalyst (a strong acid or base) accelerates the conversion.

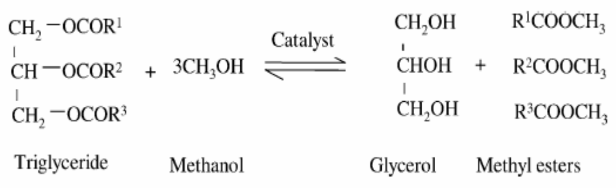

Fig. 1 General equation for transesterification of triglycerides

Transesterification of triglycerides produce fatty acid alkyl esters and glycerol. The glycerol layer settles down at the bottom of the reaction vessel. Diglycerides and monoglycerides are the intermediates in this process. The mechanism of transesterification is described in Fig.2, the step wise reactions are reversible and a little excess of alcohol is used to shift the equilibrium towards the formation of esters. In presence of excess alcohol, the foreword reaction is pseudo-first order and the reverse reaction is found to be second order. It was also observed that transesterification is faster when catalyzed by alkali [7]. The mechanism of alkali-catalyzed transesterification is described in Fig.3; the first step involves the attack of the alkoxide ion to the carbonyl carbon of the triglyceride molecule, which results in the formation of a tetrahedral intermediate. The reaction of this intermediate with an alcohol produces the alkoxide ion in the second step. In the last step the rearrangement of the tetrahedral intermediate gives rise to an ester and a diglyceride [4].

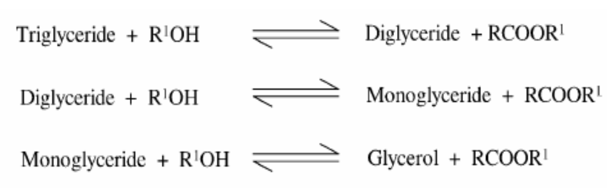

Fig. 2 General equation for transesterification of triglycerides

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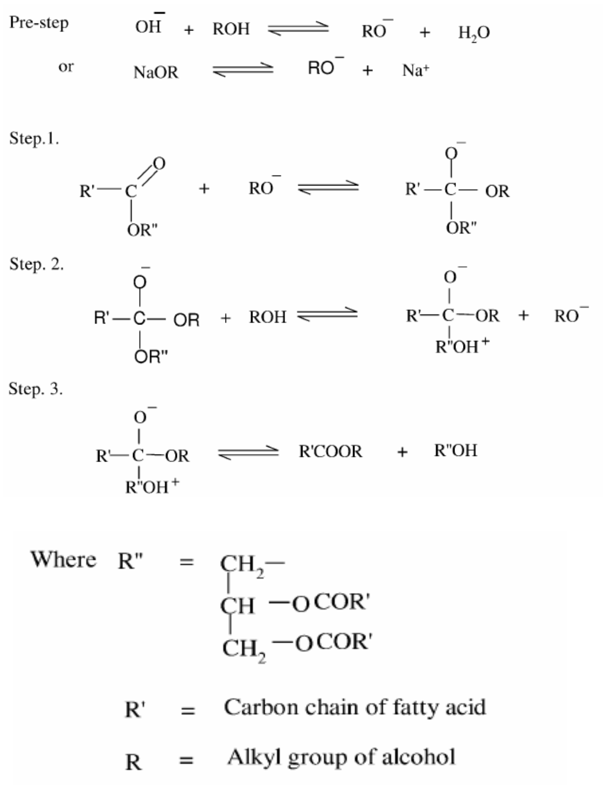

Fig. 3 Mechanism of base catalyzed transesterification

The process of transesterification is affected by various factors depending upon the reaction condition used. The effects of these factors are as bellows.

1. Effect of free fatty acid and moisture
2. Catalyst type and concentration
3. Molar ratio of alcohol to oil and type of alcohol
4. Effect of reaction time and temperature
5. Mixing intensity
6. Effect of using organic co solvents [5].

II. Experimental

A. Materials

Waste chicken fats were collected from city Slaughter House of Tehran, Iran. Fats were melted by slowly heating up to avoid any degradation. Melted fats were then filtered to remove suspended matters and residues. This chicken fat is a mixture of solid and liquid phases at room temperature.

Methanol and Potassium hydroxide (98%) were purchased from Merck.

B. Methods

Transesterification reaction is the displacement of alcohol from an ester by another to produce fatty acid alkyl esters and glycerol. It was observed that transesterification is faster when catalyzed by alkali [4].

C. Transesterification of chicken fat with methanol over the potassium hydroxide catalyst

Transesterification of chicken fat with methanol over the potassium hydroxide catalyst was carried out by a batch-type reactor. The reaction was performed by reacting 50 g of melted chicken fat; the various amount of potassium hydroxide (0.2, 0.4, 0.5, 0.6, 0.7, 0.9 g) dissolved in 11 g of methanol, were added and stirred in a 250 ml round bottom flask that equipped with a condenser. The speed of string was maintained at 600 rpm, for 2 hour at 65ºC.

At the end of transesterification reaction, the mixture was transferred to the separating funnel and glycerol layer should be settled down at funnel, Later the glycerin and biodiesel were such separated according to the different in their density by separating funnel. For purifying biodiesel (removing Catalysts and the remaining glycerin) washing operation has been performed by hot water (70ºC). The Biodiesel which contains some water has been dehydrated in vacuum using distillation by rotary evaporator.

This reaction was performed in different amounts of potassium hydroxide that was shown in Table I.

The composition of the products was analyzed by FTIR spectrometer.

TABLE I
THE RESULT OF TRANSESTERIFICATION REACTION

Sample	KOH (g)	Ester weight (g) [a]	Yield %
1	0.2	46.45	92.2
2	0.4	47.19	94.4
3	0.5	47.04	94.1
4	0.6	45.18	90.4
5	0.7	43.43	86.86
6	0.9	32,4	64.8

D. Standard fuel tests

Determination of sample properties of Chicken fat biodiesel (B100) and pure gasoil (B00) was performed by fuel standard tests. Different tests were performed on sample (the maximum yield) such as: Kinematic viscosity, Density, Flash point, Pour point, Cloud point. Obtained results were compared with biodiesel standards (ASTM D6751) in America. The results were shown in table II.

TABLE II
THE RESULT OF STANDARD TESTS

Property / Sample	Viscosity at 40 ºC **(mm^2/s)**	Density at 15 **ºC** **(Kg/m^3)**	Pour point **ºC**	Cloud point **ºC**
chicken fat biodiesel	5.5	864	5	8
Pure gasoil	3.1	830	-	3

III. Result and Discussion

A. FTIR spectrum investigation

Whereas the only change which happens in oil structure is emersion of glycerol and alternation of methanol in hydro carbon chain, in biodiesel spectrum absorptions of 1197 and 1436 cm-1 related to bending tensional vibration of –O-CH2 group. Also absorption of 1163 cm-1 in the triglyceride spectrum which belongs to bending and tensional movements of carbonyl group joined to –O-CH3 transforms to CO. pairing of peaks between ranges 1000-1500 cm-1 shows reaction progress.

IV. CONCLUSION

Now, it is distributed as a suitable commercial combination all over the world, so, in these research properties of Chicken fat biodiesel investigated. Whereas suitable stock material recognition for biodiesel preparation. Waste Chicken fat is as a suitable potential was used as biodiesel stock material. After extraction of oil and performance of transesterification reaction, produced biodiesel and properties of chicken fat biodiesel, and pure gasoil was determined by performance of standard fuel tests. Attentive to achieved results, chicken fat can be introduced as a suitable stock material for biodiesel production.

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