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A review of different biodiesel production methods, conditions, raw materials and technologies

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Abstract

Biodiesel is one of the most important strategies to complete these choices and achieve the goal. Biodiesel as biofuel can be used in diesel engines in combination with pure diesel and thus improves combustion conditions and reduces emissions. Biodiesel is produced from different biomass in different ways and processes, this depends on the potential of the area in question and the availability of bio-resources. On the other hand, the technology used in biodiesel production is also important. Given the technology and biomaterials used to produce biodiesel, economic cost and production efficiency will be achieved. Therefore, in the face of increasing demand for biodiesel production, it is important to provide a suitable way to commercialize the biodiesel production process. In this regard, different methods of biodiesel production from different sources are investigated in this research, to find the appropriate method for achieving a biodiesel production process. Based on the results of this study, biodiesel production depends on the conditions and availability of primary biofuels, but in general biodiesel production from non-food sources with alkali catalysts are of commercial importance in the process of trans-esterification; this method produces high-efficiency biodiesel (about 98%) and is economically superior to other methods.

Keywords: Biodiesel production, Renewable energy, Biofuel.

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1. INTRODUCTION

Renewable sources and biomass, which contain raw materials, are considered as a source of energy. Vegetable oils and animal fats are the sources of green energy. Depending on the consumption of fats: up to 80% in food, up to 5% in grain and up to 15% in industrial applications, for example: in drugs, surfactants, greases and therefore the share of biofuels is low and high cost have. In recent years, the production of biodiesel from edible fats has been banned due to high initial costs and food competition. The use of vegetable oils and animal fats and other derivatives as diesel fuel is almost a hundred years old (Figure 1). But their problem is in creating the problem of competition with the food needed by humans, and therefore, considering that in the past, the issue of population growth was not a threatening problem, so this issue was not very important, but in the present era, attention to Primary non-food sources such as waste oil is of great importance.

The inventor of the diesel engine, Adolf Diesel, started his engine using almond oil, and he determined that vegetable oils provide the necessary power for the engine [1, 2]. Although the use of vegetable oils can be used, their use reduces the atomizing performance of the injector and mainly settles in the injector system, and causes certain problems in the cylinders.

The aim and innovation of this study are to present various methods for converting non-edible and waste oils into biodiesel, with conventional methods and new technologies. This study compares existing methods and provides a suitable method for using production on pays industrial scale; The quality and standard of this biodiesel production depends on the technology of the production and purification process. Numerous books and articles on biodiesel production have been published [3-10] but in a manner suitable for industrial use with a focus on the raw material used and the catalyst used.

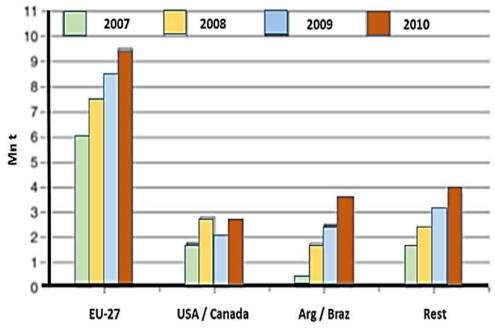

Figure 1. An overview of biodiesel production in the [1] world

The biodiesel production with maximum efficiency

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and high economic acceptance has not been studied and presented, so in this study to select the appropriate raw material and method of biodiesel production on a commercial scale and at a lower cost has been studied and appropriate technology for biodiesel production presented in the industry.

2. MATERIAL AND METHOD

Appropriate raw materials must be used to achieve biodiesel, oil, and fat refining standards. However, this creates competition between food and functional needs. Therefore, this factor has increased the attention to other sources to reduce the incidence of these problems.

2.1. Biodiesel production process and specifications of its compounds:

Biodiesel is a compound of fatty acid alkyl esters (FAAE) (mainly methyl ester), which is produced by the transesterification method of oils (Figure 2). According to theory, one mole of triglyceride reacts with three moles of alcohol to produce three moles of ester and one mole of glycerol. Methanol is the most widely used alcohol because of its low cost, but other alcohols can also be used, such as ethanol, isopropanol, and butanol.

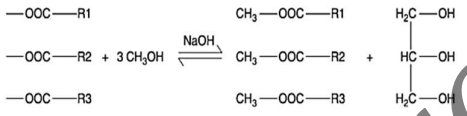

Figure 2. Transesterification reaction

2.2. Biodiesel production technologies:

Numerous methods and models have been proposed for biodiesel production. Acid catalysts are not used in the industry for transesterification in industry. However, they are rarely used in combination with alkaline transesterification, homogeneous and heterogeneous catalysts. Another new method in transesterification is the non-use of catalysts, which of course are not suitable for use in industry. The criterion for checking the accuracy of the results of biodiesel production experiments in each step of the method was the mean squared error and the use of the coefficient of explanation, which examined the level of significance. Today, the production of biodiesel using alkaline homogenization catalysts is more commercially viable. This reaction takes place by adding a nucleus from the oxide anion to the carbonyl. The catalysts used include sodium, potassium methoxide, and hydroxide [11]. Transesterification can be performed in the presence of strong acidic catalysts such as sulfuric acid, sulfuric acid, usually for raw materials with more than 5% fatty acids. The kinetics of the transesterification reaction with an acid catalyst using frying oil and cooking oils have been studied by Zhang [12].

3. Results and Discussion

Biodiesel can be produced on an industrial scale in the form of continuous and discontinuous processes. Soy (Latin America). Turnip seeds (Europe) and palm (South Asia) are suitable and stable oil products for use in the process [1]. Recycled oils are the best source that can convert high levels of triglycerides to esters in a short time. Almost only methanol is used due to its low initial cost and ease of production process. It is more common to load and use NaOH, KOH, and $NaOCH_3$ catalysts in the ratio of 0.3% and 1%. The operating temperature is between 60-70 °C and the molar ratio of CH_3OH to oil is 6: 1. In the discontinuous process, the oil is charged into the reactor with catalyst and methanol added. Stirring is then performed to form the reaction compounds uniformly, then the loading material remains constant for a while, and then the centrifuge or pump separates the glycerol layers from the biodiesel. Methanol is then recovered from the ester and glycerol layers by rapid evaporation [10].

The esters are neutralized with dilute acid and washed under vacuum pressure or with water. Purified glycerol isolated from refined FFAs is used for other purposes. In most cases, discontinuous processes take place in two-stage reactors. One of these technologies is Lurgi technology, in which most of the glycerin is separated in the first reactor, and so that by esterification of the column, methanol and excess glycerin are also separated. The produced biodiesel is then washed in a second column in a column and the glycerol and methanol are separated. Production of biodiesel can also be done in a continuous process using a tubular system such as Desmet Ballestra production technology.

This technology is described by a combination of pre-treated raw materials and transesterification. Therefore, this is its advantage and in comparison with other researches done by Methyl Bach [8] and Rimchimdt, Methyl Batch [5] and Ametta et al. [11], which use various methods and models about Biodiesel production has been done and biodiesel production has low potential and is not usable on an industrial scale, it is preferable. Desmet Ballestra technology enables biodiesel production in three series of reactors operating under mild conditions (temperature 55 °C and atmospheric pressure) and can be said to be one of the industrial methods for biodiesel production. However, only two devices have so far operated using alkaline heterogeneity catalysts. Several methods have been used on a laboratory scale, one of which is the production of biodiesel using the enzymatic method.

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4. Conclusions

Biodiesel is a renewable and stable alternative to diesel fuel. It is expected that by 2010, 5.75% should use biofuels, led by biodiesel. Appropriate raw materials must be used to achieve biodiesel, oil, and fat refining standards. However, this creates competition between food and functional needs. Therefore, this factor has increased the attention to other sources to reduce the incidence of these problems. On the other hand, due to the reduction of fossil fuel reserves and increasing environmental pollution, increasing demand for biodiesel as a biofuel is high, and choosing the appropriate method for economic production and high efficiency of biodiesel can provide; also help the country. This was one of the main objectives of this research to provide a high-efficiency, economical, and industrially applicable method by examining different methods of biodiesel production, according to the studies. In this study, it was observed that biodiesel should be produced mainly on an industrial scale by transesterification with a homogeneous catalyst, and using heterogeneous catalysts, as well as the separation of glycerol and other post-treatment processes, is easy. The proposed method of alkaline transesterification with the help of Desmet Ballestra technology was preferred. One of the benefits of this technique is the simultaneous conversion of FFAs and TAGs to FAAE. However, the applicability of the enzymatic method has not yet been investigated on an industrial scale. Numerous other modifications have been proposed to facilitate the response and to prevent pre-and post-treatment. Processes using the technique of solvents, microwaves, micro-reactors, and others have been proposed, but have not been implemented on an industrial scale. Methanol used for biosynthetic transesterification is produced from petrochemicals. Ethanol can be used to completely regenerate it. Fermented bioethanol seems to be a suitable method for green supplementation and biofuel renewal. By 2020, 20% of the fuels used should be from renewable sources, of which biodiesel is one of the most important modules to complete these choices and achieve the goal.

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