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COMPARISON BETWEEN BIODIESEL PRODUCTION FROM VEGETABLE OILS AND WASTE COOKING OILS

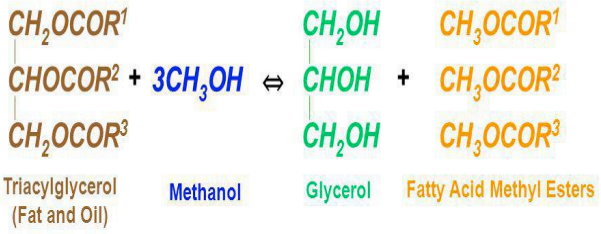
ARMELA MAZRREKU[1], ISMET BEQIRAJ[1], DRITAN TOPI[2]
[1]Department of Industrial Chemistry, Faculty of Natural Sciences, University of Tirana, Albania
[2]Department of Chemistry, Faculty of Natural Sciences, University of Tirana, Albania
Corresponding e-mail author: armelamazreku@hotmail.com

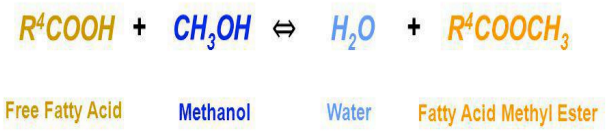
Abstract
Biodiesel has become a subject which increasingly attracts worldwide attention because of its environmental benefits, biodegradability and renewability. Biodiesel production typically involves the trans esterification of a triglyceride feedstock with methanol or other short-chain alcohol. This paper presents a study of trans esterification of various vegetable oils, sunflower, soybean, olive, and waste cooking oils, with the alkaline catalyst.
Trans esterification reaction plays an important role in converting vegetable oil or used oil into biodiesel. Reaction process may result in low yield, due to the conversion stage between oil and methanol takes place is not perfect and can lead to low-quality of biodiesel. In the trans esterification reaction; mass of catalysts, mass of methanol, FFA value, reaction temperature, reaction time, and stirring speed is a major factor determining the quality of biodiesel produced. Reactions were carried out at 65°C temperature gives lower yield of methyl ester. Using the stirrer speed is too high will cause the saponification reaction which reduce the yield generated. Use stirring speed is too high will cause the saponification reaction which will reduce the yield generated.
The results of these three variables biodiesel, has met SNI the standard and ASTM D 6751 for testing density, viscosity, cetane index, and flash point.
Key words: *biodiesel, transesterification, alkali catalysed, vegetable oil, waste cooking oil.*

Introduction

In recent years, the need for energy resources has increased with the increase of human population. Due to the depletion of world petroleum reserves and increasing environmental concerns, the interest in using renewable energy, hydroelectricity, or nuclear energy as alternative sources for petroleum-based fuels has remarkably risen [1,2]. Furthermore, biodiesel is considered as one important renewable fuel [3,4]. Biodiesel is a mixture of methyl esters with long chain fatty acids and made from vegetable oil, animal fats, or even waste vegetable oil (WVO). Biodiesel as fatty acid methyl esters (FAMEs) has many advantages such as biodegradability and non-toxicity [5]. Biodiesel also has a favourable combustion-emission profile, producing much less carbon monoxide, sulphur oxides, nitrogen hydride, particulate matter, and un burned hydrocarbons compared to the petroleum-base diesel [6]. Therefore, it is beneficial to reduce air pollution and minimize the emission of greenhouse gas by using biodiesel. These properties make biodiesel a good alternative fuel to substitute the petroleum-based diesel [7]. It is believed that large-scale production of biodiesel from edible oil may bring about global imbalance in the food supply, thus increasing the prices of edible oils. Since more than 95% of the current biodiesel is made from edible oils, many problems have been arisen accordingly [8]. Hence, the accessible utilization of WVO may be a feasible way to decrease the use of edible oils [9]. WVO is relatively cheap and considered as a potential feedstock for biodiesel production. In addition, the improper disposal of WVO frequently causes the environmental problems. However, the use of the WVO probably leads to more complex procedure and worse fuel properties in comparison with the biodiesel produced from virgin vegetable oil (VVO)

because its high content of free fatty acids (FFAs). For example, alkali catalysts are generally preferred in the conventional biodiesel industry because of their high trans esterification efficiency. However, the alkali catalyst would be consumed by the FFAs to form the emulsions that make the subsequent separation process more difficult. Thus the significant saponification phenomenon results in the low biodiesel yield when the feedstock contains high FFA amount. For feedstocks with acid value higher than 2 mg KOH g-1, a pre-treatment step is recommended to esterify the FFAs to generate esters [10]. Therefore, WVO are usually converted into biodiesel via an esterification reaction as Eq. 2 and followed by a trans esterification reaction as Eq. 1 to benefit the biodiesel yield.





The experimental conditions in the two-step procedure (esterification and trans esterification reactions) includes the molar ratio of methanol to WVO (nM/nO), the reaction time (min), the stirred speed (ω, rpm), the reaction temperature (T, °C), and the catalyst dosage based on the oil weight (Wcat, wt%). Although some studies have been conducted on synthesizing the WVO biodiesel, the nature of the WVO would remarkably depend on the feedstock source. Therefore, the detailed production procedure and fuel properties using the WVO as the biodiesel feedstock in Tirana still need to be investigated. This study presents a process to convert the WVO, which was the waste collected from a restaurant in Tirana, into biodiesel via a two-step process. Moreover, the fuel properties of the WVO and VVO biodiesels including acid value, cold filter plugging point (CFPP), density, ester content, iodine value (IV), kinematic viscosity (KV), and oxidation stability were determined and compared with the biodiesel specifications of CNS 15072 in Tirana. Fuels with low CFPP values exhibit beneficial low-temperature flow properties for vehicle engines in cold-weather climates [15,16]. A high IV value has been linked to poor oxidation stability, resulting in the formation of various degradation products, which can negatively affect engine operability by forming deposits on engine nozzles, piston rings, and piston-ring grooves [17]. Note that the lower KV is the primary reason why biodiesel should be used as an alternative fuel instead of neat vegetable oils or animal fats. A fuel with a high KV can lead to undesired consequences such as engine deposits [18]. The KV of biodiesel is approximately one order of magnitude lower than that of the parent oil or fat, leading to better atomization of the fuel in the combustion chamber of the engine. The storage of biodiesel over extended periods may lead to the oxidative degradation of the FAMEs that can compromise fuel quality [19]. The oxidation stability of biodiesel depends on the FAME composition and the quantity of natural and synthesized antioxidants in the finished fuel. Oxidation can lead to the formation of corrosive acids and deposits that may cause the increasing wear in engine fuel pumps. The oxidative instability is a major barrier to increase the acceptance of biodiesel by engine and fuel injection equipment manufacturers [20].

Material and Methods

Refined safflower oil, soybean oil, corn oil and Waste cooking sunflower oil, methanol, KOH.

Process Conditions

Pre- heating of oil: 46-50-65ºC
Pressure: 1 atmosphere
The mixture of reaction time: 60 min
Trans esterification method: the method applied is basic trans esterification with KOH as catalyst.
Feedstock: vegetable oil (soybean, corn and sunflower), waste cooking oil.

Trans esterification process

The trans esterification reaction was carried out using 100% technical grade methanol. The alcohol used was 160ml per litter of vegetable oil. First the alcohol and catalyst mix to form methoxide. Then oil were poured into the reactor vessel in which the reaction was to be carried out. When the temperature was 50°C we put into the vessel

methoxide. Trans esterification was carried out using a heating plate and a magnetic stirrer.

Results and Discussion

Table 1 summarizes the physic-chemicals indicators of biodiesel producing by different raw materials. And figure one shows us the different appearance of biodiesel.

Table 1: Physic-chemical characteristic of process of trans esterification basic and qualitative indicators biodiesel

	Physic-chemical indicators	Biodiesel from WCO	Biodiesel from soya	Biodiesel from sunflower	Biodiesel from corn
1	Density of biodiesel; (t= 24 ºC)	0.891	0.893	0.874	0.893
2	Density of biodiesel; (d_4^{20}); (gr/cm^3)	0.8925	0.8946	0.876	0.8946
3	Angle of refraction ; (n_D^{24})	1.471	1.473	1.458	1.473
4	Flash point; (ºC)	222ºC	238 ºC	108 ºC	238 ºC

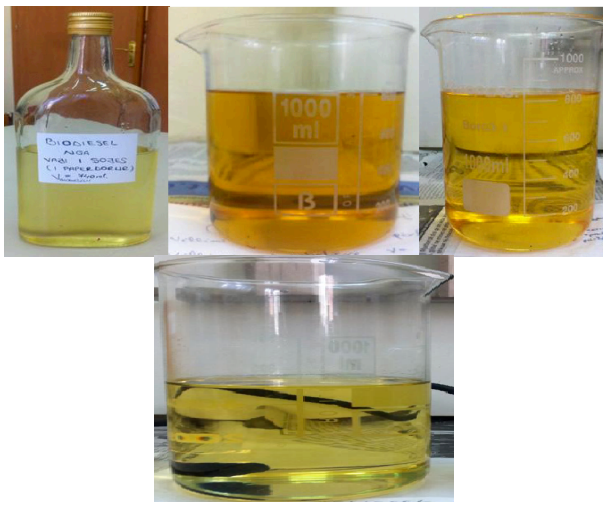


Figure 1. Biodiesel from soya, from WCO, from corn and from sunflower oil

Conclusions

Thus Bio Diesel was prepared from used vegetable oil, the properties resembled closely to that of commercial Diesel. Hence it can be used as an alternate for diesel. It is relatively economic than diesel and emits less pollutants. It can be used for Vehicular use, Railway usage, as heating oil when blended with other fuel oil in proportion. The experimental work carried out in this project shows that bio-diesel of acceptable quality can be produced on a small scale from a number of low-cost raw materials. However, the search for alternative feed-stocks needs to be continued. More research on the esterification of used vegetable oil is needed, to establish process requirements for high yield and quality, and to find ways of improving its low-temperature properties so that a higher proportion could be included in bio-diesel blends. The ester yields obtained from all the oils used in these trials have been low in comparison with those obtained from refined vegetable oils in existing large-scale plants. Rising of yields has a significant effect on the economics of bio-diesel production. Modern technology is giving very high yields; it needs to be demonstrated that the same can be achieved with other raw materials, whereas more information is required on alternative uses for small amounts of glycerol. On this scale, the investment required to produce pharmaceutical grade glycerine could not be warranted. Uses that require a minimum amount of additional plant investment, but add maximum value to the produce, need to be examined. When a use for the glycerol has been decided a plant for the removal of methanol and any further processing of the glycerol can be specified. In this work, biodiesel was prepared using alkali catalyzed method where the raw material used was waste sunflower oil used for cooking. Biodiesel can also be manufactured using non-edible oil such as pongamia oil as raw material. Further studies can also be carried out by modifying the catalysis. i.e. by using either acid-base or algae as the catalyst.. Increased utilization of renewable bio fuels results in significant microeconomic benefits to both the urban and rural sectors, and the balance of trade. The chief advantage of Biodiesel for agriculture is cost minimisation. The expression "oil well on your farm" means in fact a higher local value added. Oil plants renew themselves every year. In any event, the focus is not only on providing emergency

supplies but also to a large extent on reducing the pollution load produced by day-to-day operations.
The flexibility of Biodiesel plants is also a response to another energy target: the creation of manageable regional supply systems. The production of biodiesel is relevant for developing countries where the demand of transport fuels is going to increase to a great extent. A high-quality research is promoted in support of a sustainable development of society covering subjects of strategic importance to economic and social development and aiming a greater energy self-sufficiency and security in addition to environmental (decreasing the air pollution from transportation and mitigating greenhouse gas emissions) benefits. The biodiesel fuel production has gained importance for its ability to replace fossil fuels, its environmental benefits and the fact that it is a renewable source of energy. Since the direct usage of vegetable oils as biodiesel is impractical, many processes have been developed to convert them into a suitable form.

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