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Laura Nushi
University for Business and Technology - UBT

Sami Makolli
University for Business and Technology, sami.makolli@ubt-uni.net

Agron Millaku
University for Business and Technology - UBT

THE PRODUCTION OF BIODIESEL USING WASTE COOKING OIL IN KOSOVO

Laura Nushi[1], Sami Makolli[1], Agron Millaku[2]

[1] *Departament of Energy Eficciency and Management,*
UBT University of Business and Technology,
Pristina ,Kosovo,
lauranushi@gmail.com

Abstract. The need for energy, fossil fuels and the emissions generated from these fuels are increasing daily. In recent years, biodiesel has attracted attention as a renewable, biodegradable, and non-toxic fuel. Its production from waste cooking oil (WCO) provides an alternative energy means of producing liquid fuels from biomass for transport uses. Biodiesel production by recycling WCO and methanol in the presence of kaliumhydroxide (KOH), offers several benefits. In order to know ahow the Kosovo market is prepared for biodiesel production and its potential, we researched the market by interviewing the workers from the gastronomy sector so we could calculate how much oil is being yearly wasted, and the amount of energy too. In addition, this work highlights the purification and analysis of the produced biodiesel in a chemical laboratory, the operating parameters, the air pollution related to it, several economic and energy studies based on statistics.

Keywords: Waste cooking oil, transesterification, biodiesel.

1 Introduction

Energy in its general term, whether directly or indirectly, is essential for terrestrial life (including biotic and abiotic organisms), viewed from a biological point of view. In physics, energy is the "quantity" that must be transferred to an object in order to perform work or to heat that object. For chemists, energy represents the capacity of a body / matter to perform work, where this is achieved by maneuvering with atomic bonds within matter. The reason why we have mentioned above some definitions of the word "energy" aims to facilitate the creation of a concept of what is energy in the natural sciences versus the terms we use in our daily lives such as electricity, thermal energy, etc.The last two forms of energy mentioned above in Kosovo are unfortunately still not stable and as a sector is not part of what we call "sustainable development".

One of the main reasons has to do with the state of the environment, where I now believe that we are all aware that not only the plants in Obiliq negatively affect the environment, but also the load that Kosovo has suffered, especially during the last two decades. When we talk about this kind of "load", this should also mean urbanization, where consequently the demand for food, transportation, etc. has increased.

The main purpose of this paper is to show the production potential of biodiesel that Kosovo has from the use of waste oils, the ways of its production, as well as the impact on the environment that this change would bring.

2 Biodiesel

2.1 Definiotion of biodiesel

Biodiesel is an alternative liquid fuel similar to conventional 'fossil' diesel. It can be produced from direct vegetable oil, animal oil / fats, bark and cooking waste oil. Although oil directly from the agricultural industry represents the largest potential source to produce biodiesel, this oil is not taken for production, simply because crude oil is much more expensive and the cost of converting it to biodiesel is very high in the market compared to with fossil diesel (oil).

Table 1. Characteristics of biodiesel

Name	Biodiesel
Form	Liquid
Colour	Yellow
Density at 15° C, kg/ m³	884,0
API Density	28,56
Flash point, ° C	130
Cloud point, ° C	340 - 370
Viscosity mm²/s [2]në 40° C	5,2
Acidity number, mg KOH/g	0,015
Copper residue, g/ m³	6
Fatty Acids, %	5
Carbon resiude (In 10%), %	0,4
Cetane Number	51

2.2 History of biodiesel

In 1890 Rudolf Diesel invented the engine which worked with diesel. However, because cheap diesel fuels were readily available, few people were interested in other alternatives such as the use of other oils / fuels. In 1900 at a show in Paris the first engine appeared which worked using peanut oil, and it was during the following decades that interest in using other oils as fuel increased.It was a Belgian Georges Chavanne, professor of chemistry, who in 1937 first proposed the use of transesterification as a process to convert vegetable oils into alkyl esters with fatty acids, and use them as a substitute for diesel fuel. This product is now known as biodiesel. A year later, a bus covered 20000km from Brussels to Leuven, using biodiesel as fuel first.In May 1940, the university was closed due to the events of World War II, and a year later Chavanne passed away. The first biodiesel production plant started operating in 1985 in Austria.

2.3 The process of making biodiesel

Biodiesel production methods can be divided into "**physical**" and "**chemical"** methods based on biodiesel processing.

Physical methods can be divided into:

- Direct mixing method;
- Microemulsion method;

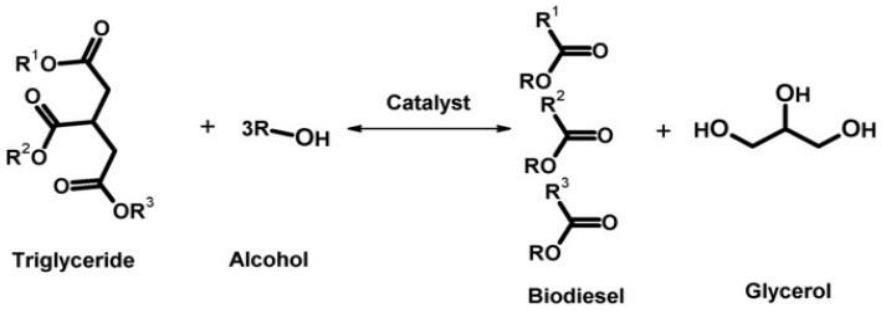
Chemical methods can be divided into:

- Pyrolysis method;
- Transesterification method;

2.3.1 Transesterification

Biodiesel is produced through a chemical process called transesterification. During this chemical process a triglyceride (fat / oil) reacts with an alcohol (mainly methanol) and catalyst (usually a strong alkaline like sodium hydroxide) to form esters and glycerin. Triglyceride is a "big" molecule, made up of the glycerin molecule which is linked by three chains made up of fatty acids, which means that all the oils in nature in their chemical structure are made up of triglycerides. As the temperature increases, we will be able to break down triglyceride from its fatty chains, replacing the latter with methanol. As a result we get Fatty Acid Methyl - Ester (if we use ethanol, then we will have Ethyl - Ester), which we know as biodiesel. Because glycerin molecules are denser, they will float down, while at the top we will have the biodiesel produced. In the laboratory we produced biodiesel by using 99.99% concentrated methanol and KOH as a catalizator.

Picture 1. The chemical reaction of making biodiesel



2.4 The advantages and disadvantages of biodiesel

2.4.1 The advantages

• Renovable,
• Can replace diesel and mix with it;
• Has a high boiling point;
• Can be produced from most animal and vegetable oils;
• Reduces greenhouse gases by up to 86%;
• Reduces pollutant particles by 47%, reduces smog thus affecting air purity,
• Reduces hydrocarbon emissions by 67%;
• It is non-toxic, has low sulfur content, diesel smoke on the contrary can cause various diseases or even death;
• Maintains the car engine, and is easier to maintain;

2.4.1 The disadvantages

• Major change in biodiesel quality;
• Not suitable for use at low temperatures;
• Biodiesel can damage the rubber bands of engines and their filters as well;
• It is more expensive than diesel;
• May cause the engine to stall and reduce its performance;
• Lack of food;
• Not all regions are suitable for oil-producing crops;
• Fuel distribution;
• Slight increase in nitrous oxide emissions;

3 Kosovo – Study Case

To calculate an average as realistic as possible, it is more than aware that the more samples we possess, the more accurate our result will be. Due to the fact that not all businesses in the gastronomy sector were equipped with fryers for frying potatoes (food), we did not take into account their data in the research. The questions listed above were addressed to the staff of the gastronomy sector in Kosovo, (i.e. only to those restaurants which were supplied with oil in larger quantities), for frying food. Their average responses are as follows:

1) How many liters of oil per week do you use on average?
25 liters of oil per week;
2) How much oil is left?
20 liters of oil left per week;
3) Do you use the remaining oil for any other purpose?
68% said no; 32% said yes;
4) Would you offer the remaining oil for a certain amount to a company that would use this remaining amount?
28% said no, 72% said yes;
5) How much do you think the price offered should be?
More than 15cent / l;

4 Conclusions

The active number of restaurants registered in Kosovo is 6052. Of the total number we interviewed, 70% of restaurants used oil to a greater extent for frying food. If we refer to this research we find that:

6052 active restaurants - 30% = 4240 restaurants use frying oil;
4240 restaurants * 20 liters of oil per week * 52 weeks per year =
= 4,409,600 liters per year;

If from a liter of used oil, at least 85% can be converted in biodiesel then:

4,409,600 liters of oil * 85% = 3,748,160 liters of biodiesel per year;

Converting this amount into energy is:

3.748.160 * 37.27 MJ = 139.693.923 MJ = 140000GJ = 140TJ;
140TJ * 277.778MWh = 38889MWh;

Also this amount of energy would be paid for € 71.3 MWh, according to the Feed In tariff (incentive tariff for the production of electricity from biomass), then the amount lost in this case is:

***38889MWh** * 71,3 €MWh = 2.772.785 €/year;*

The remaining cooking oil is cheap, available in abundance and will always be found in stock. Its more controlled use or treatment for biodiesel production would bring numerous benefits, both economically and environmentally.

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