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# Valorization of Used Frying Oil Through Biodiesel Synthesis

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**ABSTRACT**

The increase in the world's population has led to an increase in the development of food processing industries. These industries generate huge amounts of organic waste which is mainly composed of triglycerides. This waste can be converted into biofuel for engines. The conversion of these wastes into biodiesel is very promising due to its compatibility with diesel engines and its characteristics very close to diesel. In the present work, waste cooking oil is considered as an energy source for diesel engines. For this purpose, we used transesterification as a process to valorize this waste into biofuel, and then we compared it with conventional diesel. The analysis of the results obtained showed that our biodiesel, obtained from the valorization of edible frying oils, has a positive impact on the environment. Nevertheless, it turned out to be a non-compliant product due to its behaviour towards the engine, so its use in its pure state (B100) as a transport fuel cannot be implemented due to many serious concerns. The result is that a mixed diesel-ester system as a fuel is required.

**Keywords:** Food waste; transesterification; biofuel; fossil diesel.

## 1. Introduction

Currently, around the world, raw material resources are diminishing and the majority of the world's energy production is based on fossil fuels. As a result, environmental pollution is increasing and continues to have more and more visible effects on the planet. This problem requires remediation, hence the interest in using so-called renewable resources, which constitute a strategic sector and occupy a privileged place in the fields of research and development. The search for a new, inexhaustible source of natural energy, together with a technology that does not involve oil and its refining, has resulted in the emergence of biofuels. The use of biofuels is a cleaner alternative to oil. Biofuels are fuels produced from renewable, non-fossil organic materials, and belong to two main families, gasoline substitutes (bioethanol) and diesel substitutes (biodiesel). The objective of this study is to produce biodiesel from used cooking oil and compare it to conventional diesel [1].

## 2. Experimental

The production of biodiesel was carried out by transesterification of UFO (Used Frying Oils with a frequency of use not exceeding five times) with methanol. The operating conditions involved in the reaction were established following preliminary studies. We considered it useful to study the influence of the reaction temperature on the yield and quality of the biodiesel. The oil used can be used directly as a fuel due to its high calorific value (about 80% of that of petroleum diesel), but its only disadvantage is its high kinematic viscosity, which is 10 times higher than that of diesel at 40°C, which causes certain problems such as carbon deposition, clogging of fuel lines, gelling of lubricating oils, clogging of piston heads, and poor atomisation by the injectors, and hence poor combustion. In order to reduce the viscosity of this oil, the transformation of lipids into the corresponding esters is essential. Transesterification is the most common method. We used sodium hydroxide (NaOH) and methanol ($CH_3OH$) as reagents with an alcohol/oil molar ratio of 6:1 and a concentration of 1,597 mol/L NaOH.

## 3. Results and Discussion

Several parameters on the evolution of the biodiesel yield have been studied, Like: reaction time agitation and reaction temperature. Stirring is a very important parameter in the transesterification reaction, as the oils are immiscible with a solution of sodium hydroxide and methanol. Increasing the temperature



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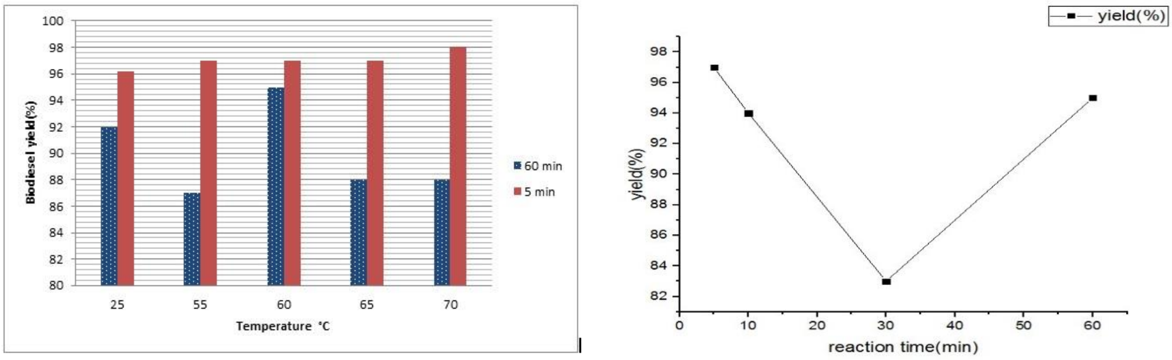
accelerates the reaction and allows higher yields to be achieved, which may be due to a reduction in the viscosity of the oil at higher temperatures as well as faster separation of glycerol from the biodiesel. In figure 1, we show the evolution of the biodiesel yield as a function of reaction time at a temperature of 60°C (a) and as function of temperature from 55 to 70°C for a reaction time of 5 and 60 minutes (b).




-a - -b-

**Figure 1:** Evolution of biodiesel yield as a function of: **a**-reaction time, **b-**temperature.

Initially, an increase in reaction time resulted in a decrease in yield because reactions require a certain amount of time to reach thermodynamic equilibrium. After 30 minutes, we observe an increase in yield which may be due to the conversion of almost all of the reactants into biodiesel. for very slow times the hydrolysis reaction of the esters is favored. An ambient temperature of 25°C leads to a biodiesel yield of 96.17% for a reaction time of 5 min and 92% for a reaction time of 60 min.

## 4. Conclusions

The analysis of the results obtained showed that our biodiesel, obtained from the valorisation of edible frying oils, has a positive impact on the environment. Nevertheless, it turned out to be a non-compliant product due to its behaviour towards the engine, so its use in its pure state (B100) as a transport fuel cannot be implemented due to many serious concerns. The result is that a mixed diesel-ester system as a fuel is required. The UFO transesterification reaction can be carried out at room temperature and 5 min time reaction with a good biodiesel yield while reducing energy consumption.

## References

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