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Physico-chemical properties "Lio" vegetable oil and its biodiesel

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ABSTRACT

The objective of our work is to make a comparative study of the physico-chemical properties between Lio oil and biodiesel obtained from it (biodiesel synthesis by transesterification of the Lio oil). This comparison has shown that the density and viscosity of the Lio oil was a bit high, but after the transesterification it has decrease remarkably. It allowed us to make the conclusion that the biodiesel obtained has very similar properties with the biodiesel used by the engines.

Keywords: density, viscosity, Lio oil, transesterification, biodiesel.

INTRODUCTION

The increasing cost of fossil hydrocarbons and the perspective programmed exhaustion of this non-renewable natural energy resource, in addition to the global warming phenomena attributable to greenhouse gas emissions in the atmosphere, have led researchers to think about the development of new environmentally clean and economically viable energy resources.

Among these renewable energy resources, we find the bioenergy in general and biofuels in particular. Biofuels are fuels derived from biomass (the total organic material derived from plant or animal) and their transformed products [1].

The idea of producing fuels from renewable raw materials is not new. Before the oil era, fuels at the beginning of the automobile were made from plants. Indeed, a combustion engine was designed by N. Otto to use the ethanol; while Rudolf Diesel was turning his engine by peanut oil in 1900. Moreover, Busses (before 1914) and cars (eg. Ford T in 1903-1926) were working with alcohol [2].

During the two oil crises (1973 and 1979), the farmers have used the canola oil to replace the petroleum oil in their tractors. However, the use of vegetable oils in tractors could not be optimal until the engine became hot because of their high viscosity and low cetane index compared to diesel, which led the French Petroleum Institute (IFP) to conduct research on the use of vegetable oils as fuel. Research has shown that the esterification of vegetable oils increases the cetane index and makes it closer to that of diesel [3].

Vegetable oils are generally of very low toxicity and have an excellent biodegradability. These qualities are due to their low resistance to oxidation and hydrolysis, which both are favorable ecotoxicological aspects [4].

The fuel produced is then more fluid than the vegetable oil (decrease in viscosity). This reaction is called transesterification.

MATERIALS AND METHODS

2.1 Density Variation

Density (d) provides information on the begining, the oxidation or the polymerization state [5]. In our study we used Lio oil and biodiesel made from the same oil. The density measurements are shown in Figure 1.
The density results of the oil as a function of temperature.

2.2 Viscosity variation

Kinematic viscosity (η): it is a property of the oil, resulting from the resistance of its molecules opposed to a force tending to move them by sliding. It varies with the temperature [5].

The results of measuring the viscosity (mm^2 / s^{-1}) of Lio oil and biodiesel as a function of temperature are shown in Figure (3).

2.2.1 Materials :

The viscosity is measured by an Osswald viscometer:

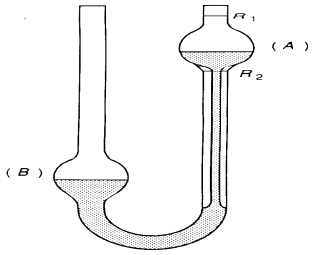

Fig 1 : Osswald viscosimeter

2.2.2 Methods :

- **Measurement of the viscosity of vegetable oils :**

It consists on measuring the time during which a volume V of the fluid is passing through a capillary tube. The viscosity is proportional to the flow time as:

$$\nu = K \cdot \Delta t$$

The constant K of the device is given by the viscosimeter's manufacture.

Résultats

We have studied the variation of density and viscosity of Lio oil and its biodiesel as a function of temperature. The results obtained are represented in figures 1 and 2.

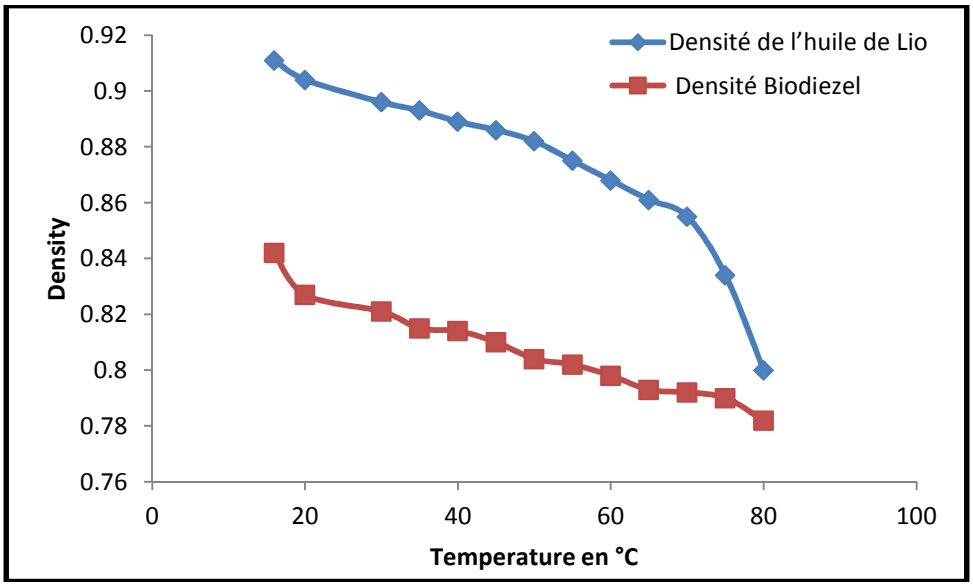

Fig 2 : Density mesurements of Lio oil and its biodiesel

3.1 Variation in density

Figure (1) represents the density variation as a function of the Lio oil and biodiesel temperature.

From Figure (2), it is observed that the density of Lio oil and biodiesel decreases with increasing temperature. However, their decrease shapes are not similar. It is observed normal for Lio oil, as it decreases linearly until the temperature T = 70°C, before it falls rapidly between T = 70°C to 80°C. On the other hand, the density of the biodiesel falls exponentially.

3.2 Variation in viscosity

The results of measuring the viscosity (m^2/s) of Lio oil and biodiesel depending on the temperature are shown in Figure (2).

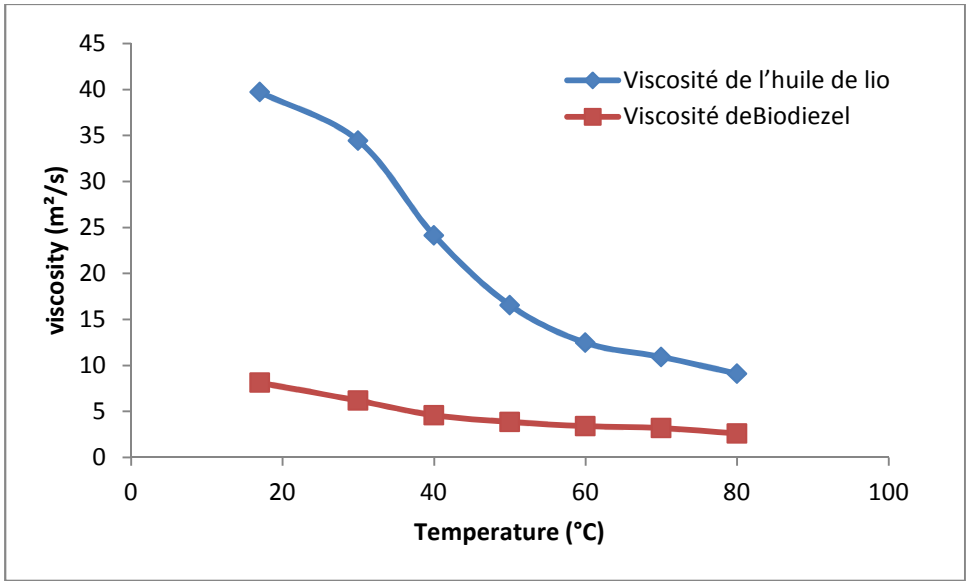

Fig 3 : Viscosity measurement of Lio oil and its biodiesel

In figure (2), it is noted that the viscosity decreases with increasing temperature, and the most interesting thing is that the viscosity of the biodiesel synthesized from this oil is less as compared to Lio oil.

DISCUSSION

From the results obtained above (variation in density and viscosity of Lio oil and its biodiesel), we may well infer that one can easily use biodiesel Lio as biofuel.

CONCLUSION

Biodiesel is one of the most important renewable energy resources. It is non-toxic, biodegradable, its calorific value is important, its sulfur content is low and its use reduces the unburned emission. It can also be used in diesel motors without introducing any modifications on them. However, it has technical problems with its flow properties at low temperature, its NOx emissions and its stability during storage.

Biodiesel is synthesized by transesterification, which is the most widely used technique for its synthesis. It is a reversible chemical reaction that consists on replacing organic group R″ of an ester with the organic group R′ of an alcohol. The presence of a catalyst greatly favors this reaction. This method is widely used to reduce the viscosity of triglycerides [6] [7].

In this study, we applied this technique to synthesize biodiesel from Lio oil. We studied its physico-chemical properties to ensure that the obtained biodiesel could be used as biofuel. Thus, two parameters have been checked for the oil and its biodiesel, namely the variation in density and viscosity versus temperature. The analysis of those parameters allowed us to draw the following conclusion:

- The low density and viscosity of the biodiesel compared to those of Lio oil

Finally we propose to study, in the future, the parameters influencing the transesterification reaction. A complete characterization of the biodiesel obtained must be realized as well.

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