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Modeling of the electrical resistivity of the vegetable Prickly pear oil

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ABSTRACT

Some plant oils have similar electrical and thermal properties, or better than current liquid dielectric with superior environmental performance. In transformers, a stable liquid, inert, having good electrical and thermal properties is required; outside this liquid must be non-toxic to the environment and readily biodegradable. The intrinsic properties of natural vegetable oils, in terms of fire resistance, environmental performance and electrical and thermal characteristics, dielectric compositions are particularly useful products in the field of electrical engineering. In this work we report measurements of the resistivity of the prickly pear oil. The use of this electrical method was made at 25°C and 100°C. These measurements show that the viscosity decreases as the temperature believes. This decrease in viscosity was attributed to the effect of thermal agitation on the structure of molecules of these oils. This study may be useful for a possible application of these oils in the technological field.

Keywords: Electrical Resistivity, Dielectric Transformer.

INTRODUCTION

Energy demand in the world today is experiencing tremendous growth mainly due to the development of the transport sector and industry. [1-2] Also, oil and hydroelectric sources prove they insufficient to meet that need. To get away from the rupture, the oil countries are trying to slow down the export of their reserves [3]. This attitude is the cause of various fluctuations and increases in oil prices, causing economic consequences all over the world and particularly in developing countries. Also, the exploitation of fossil energy she has harmful effects on the environment in which the heating of the earth and climate change [4, 5]. Vegetable oils are increasingly used, in pharmacy, cosmetics etc ..

The electrical properties of oils depend upon their chemical composition and molecular.

The electrical resistivity and dielectric strength are the main electrical properties of a substance. The electrical conductivity of an oil is due to the presence of free charges, and under the effect of an electric field, these charges move to thereby give an electric current.

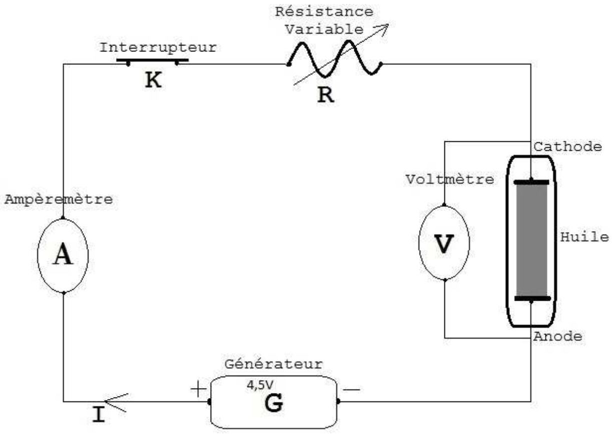
The electrical resistivity ρ is a fundamental parameter in non-destructive characterization of the compounds [6, 7]. The study of electrical conductivity as a function of oil temperature: Prickly pear allow us to better characterize this oil.

MATERIALS AND METHODS

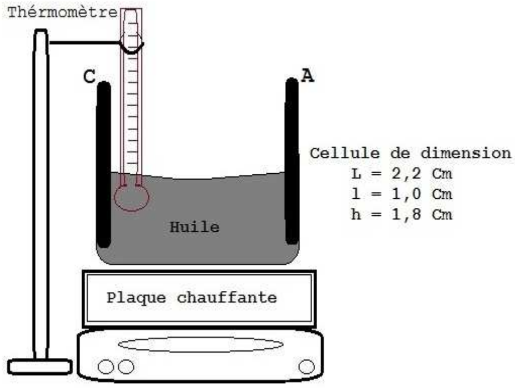
We used the resistivity measurement method known as "two points method": the electrical resistance of the oil is determined by measuring the current and potential difference between the two electrodes of the cell (see montage).

1.1.**Materials :**

Schema of the cell used to measure the electrical resistivity.



a. Montage of the equipment used.



b. cell of measurement of reistivity.

2.2 **Methods**

Computation of the resistivity was based on the following formula:

$$\rho = R \times \frac{S}{L}$$

Where ρ : Electrical Resistivity (Ω.cm) ; R : Resistance (Ω); S : Section (cm²); L : length(cm)

2.3 **Modelisation**

The variation of the resistivity of vegetable oils as a function of the temperature is modeled with the Arrhenius equation:

ρ = ρ0exp (Ea / RT).

Where ρ is the resistivity, ρ0 is the pre-exponential factor (Ω / m), Ea is the activation energy (J / mol); R is the ideal gas constant (J / mol / K), and T is the temperature (K). P0 the value may be approximated as high-temperature resistivity (ρ0 of ρ∞).

Equation (1) can be rewritten as follows:

ln (ρ) = ln (ρ0) + (Ea / RT).

The objective of this work is to adapt our results by the Arrhenius equation, and determine from this modeling, the physico-chemical characteristics of the oil studied.

RESULTS AND DISCUSSION

2.4 Results

The measurements of the electrical resistivity of Prickly pear oil are shown in Figure 1.

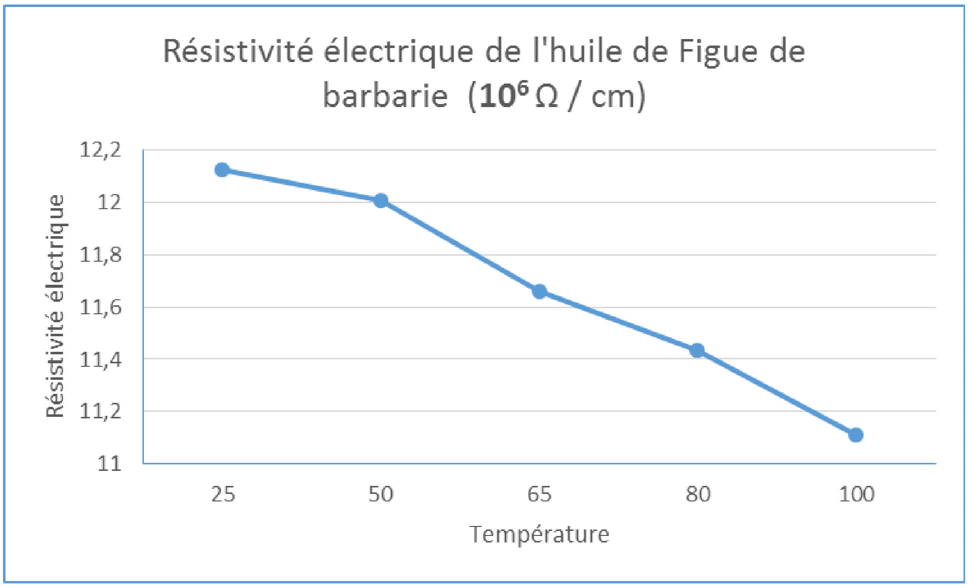


Figure 1 : Electrical resistivity of the vegetable oils of prickly pear (10^6 Ω / cm)

The results of the modeling of the vegetable oil, prickly pear are shown in Figure 2.

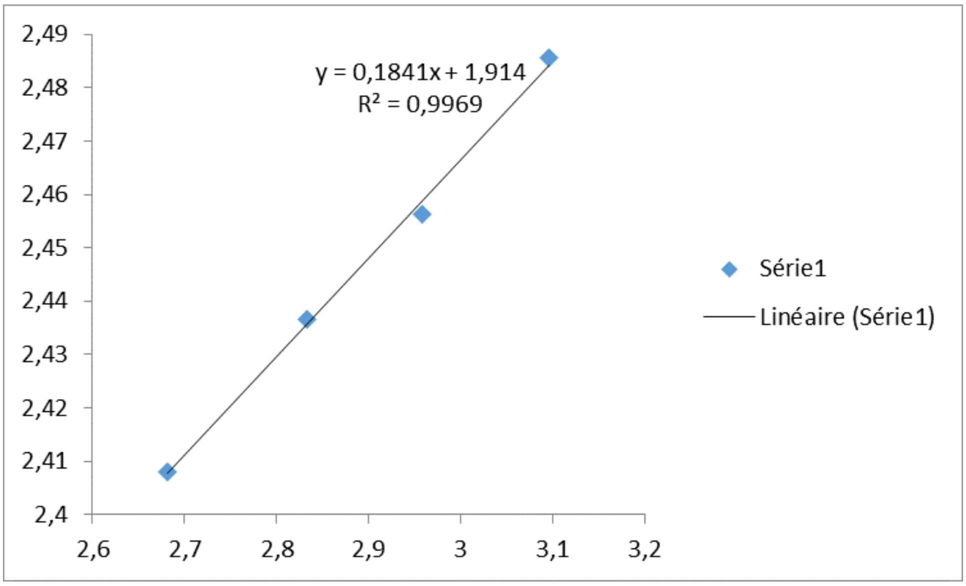


Figure 2 : Modeling of the electrical resistivity of the Prickly pear oil

Table 1: Important parameters of the ln(electrical resistivity) versus temperature fit

sample	ν_∞ ($x10^6$Ω,cm)	E_a(KJ/mole)	R^2
Prickly pear oil	1.53171	6.78	0.9969

DISCUSSION

Our study allowed us to compare our results on the behavior of the resistivity as a function of temperature with those of other researchers working on the same research topic . [8-9] . Electrical measurements of oils as a function of the temperature, and it can be used as a strong indicator of the degradation of alimentary quality oils at high temperature [8-9] .

CONCLUSION

The physical-chemical measures of he oils can provide information on the oil studied, looking ahead, we are planning to complete our work by studying the thermal resistivity and viscosity of these oils, depending on the temperature.

• The electrical resistivity of vegetable oil Prickly pear, decreases with temperature, and experimentally as pre-predicted by Arrhenius equation.

• The activation energy and the pre-exponential term was obtained. These results can be used as a means to characterize the quality of the oil. These values depend on the nature of the oil.

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