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Temperature-dependent Changes in the Dynamic Viscosity of Oxidized and Non-oxidized Olive oils

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ABSTRACT

The Azian equation was used to analyze how dynamic viscosity changed with temperature. The Azian equation, which may be used to explain how dynamic viscosity depends on temperature, is found to better approximate the actual data when the correlation coefficient values of the two equations are examined. At every speed and temperature at which the oils were tested, the analysis of the experimental data revealed that olive oil had the least amount of temperature-dependent dynamic viscosity increase. Since oils with a high degree of dynamic viscosity stability are required in industrial applications, the increase in dynamic viscosity of vegetable oils during the oxidation process might serve as a criterion for assessing the oxidation of oils.

Keywords: Oil, Olive, Unoxidized, Oxidized, Rheology.

INTRODUCTION

From an environmental protection perspective, biodegradable lubricants are especially interesting. Generally speaking, polyglycols, synthetic ester oils, and vegetable oils can be utilized as base oils for biodegradable lubricants[1].

According to a market analysis, the proportion of non-polluting fluids made from vegetable oils grew steadily from 2% in 1980 to 8% in 2000. Palm oil has had the largest increase in industrial use, followed by rapeseed and soybean oils.

Tribologists are interested in the lubricants made from vegetable oils because of their quick biodegradability, non-toxicity, and comparatively endless supply. For the same purposes, biodegradable lubricants made from vegetable oils function similarly, if not better, than mineral oils. Vegetable oils, however, behave poorly at low temperatures, have poor hydrolytic stability, and have limited oxidation stability.

The future acceptance of vegetable oils on the lubricants market depends, among other things, on the possibility of using an additive that reduces or eliminates the high, unwanted reactivity of these lubricants due to the labile structural elements.

Research work to improve the properties of these lubricants must be carried out so that the use of additives, which are generally non-ecological, does not influence the non-polluting characteristics of vegetable oils[2-9].

The studied documentation shows the interest in vegetable oils, but also the need to test them to determine their characteristics and influencing factors.

Equation Azian is[3-11]:

$$\ln\eta = A + \frac{B}{T} + \frac{C}{T^2} \quad (1)$$

Where T is the absolute temperature, and A, B and C are material constants[12-19].

MATERIAL AND METHODS

The Rheotest2 establishment was used to determine the range of thickness based on temperature and shear rate. In order to oxidize the olive oil, it must be heated to temperatures of 120°C and 130°C for 5 h and 10 h , respectively. The level of energy of the oxidized oil was determined for temperature range of 30°C to 90°C and shear rate between 3.3 s^{-1} and 80 s^{-1}. The energetic consistency decreases as the shear rate increases, at different temperatures and oxidation.

RESULTS AND DISCUSSION

Figures 1 and 2 appear the varieties of energetic thickness with temperature for oxidized olive oils at temperatures of 120°C and 130°C, for 5 h and 10 h, comparing to shear speeds of 3.3 s^{-1} and 80 s^{-1}. At both temperatures and oxidation periods of time, individually shear speeds, the energetic consistency diminishes with the increment of the temperature at which the oils were tried. The oxidation of olive oil at a temperature of 120°C, for 5 h and 10 h , does not cause noteworthy increments within the energetic consistency of the oils compared to the non-oxidized oil, a wonder watched at both shear rates at which the oils were tried. Expanding the oxidation temperature from 120°C to 130°C, the energetic thickness of the 5-h oxidized oil does not alter much compared to the energetic thickness of the non-oxidized oil. An imperative increment in energetic consistency is watched when the oxidation period increments from 5 h to 10 h, for both shear rates.

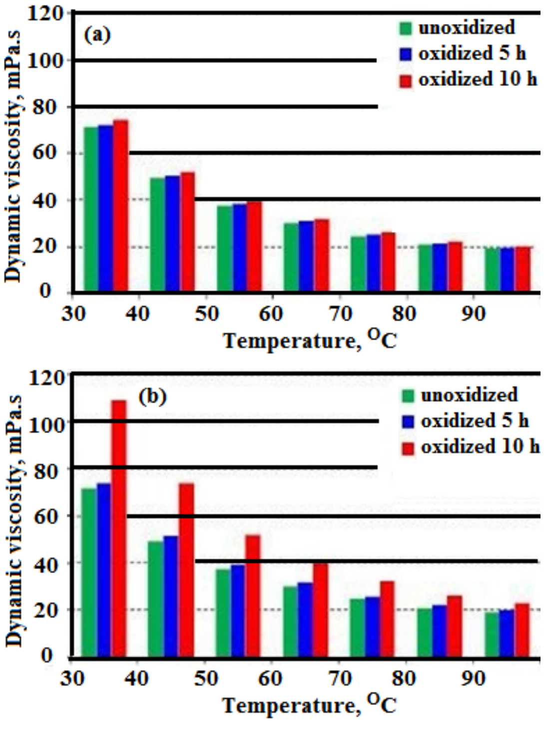

Fig. 1. Variety of dynamic viscosity with temperature, at a shear rate of 3.3 s^{-1}, for oxidized olive oil at a temperature of 120°C (a) and at a temperature of 130°C (b)

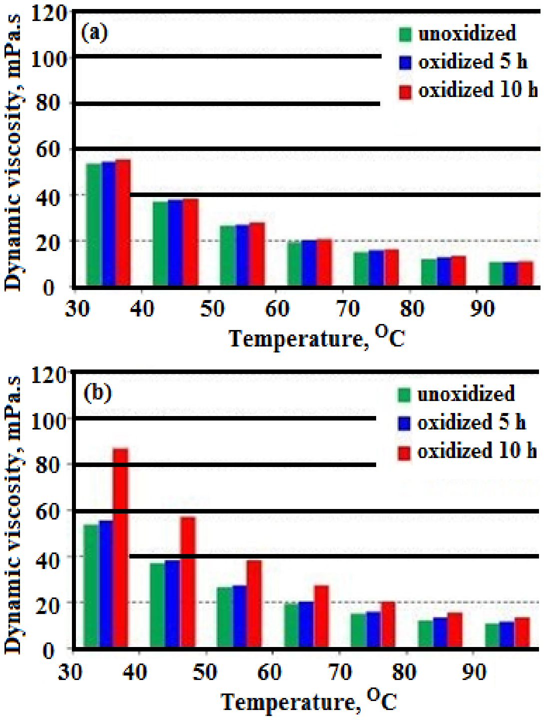

Fig. 2. Variety of dynamic viscosity with temperature, at a shear rate of 80 s^{-1}, for oxidized olive oil at a temperature of 120°C (a) and at a temperature of 130°C (b)

The variation of dynamic viscosity with temperature of oxidized olive oils was analyzed using the Azian equation (1). The Azian equation approximates the experimental data very well, the correlation coefficients having values between 0.99971 and 0.99996, this equation can be used to describe the variation of dynamic viscosity with temperature.

As a conclusion, Fig. 3, 4 and 5 show, in the form of viscosity maps, the combined influence of temperature and shear rate on dynamic viscosity, for olive oil (unoxidized, oxidized for 5 h and 10 h, respectively, at temperatures of 120°C and 130°C respectively). A visible change was obtained for olive oil oxidized for 10 h at a temperature of 130°C, for which the viscosity has much higher values (see Figure 5.b).

Figures 6 and 7 appear the focuses that speak to the test values and the surfaces that surmised these exploratory values, for olive oils oxidized at temperatures of 120°C and 130°C for 5 and 10 h, individually.

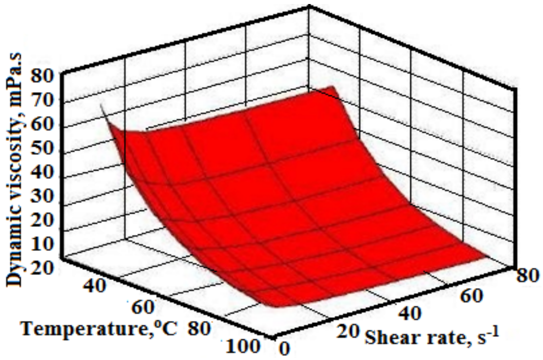

Fig. 3. Viscosity variation map with temperature and shear rate for non-oxidized olive oil

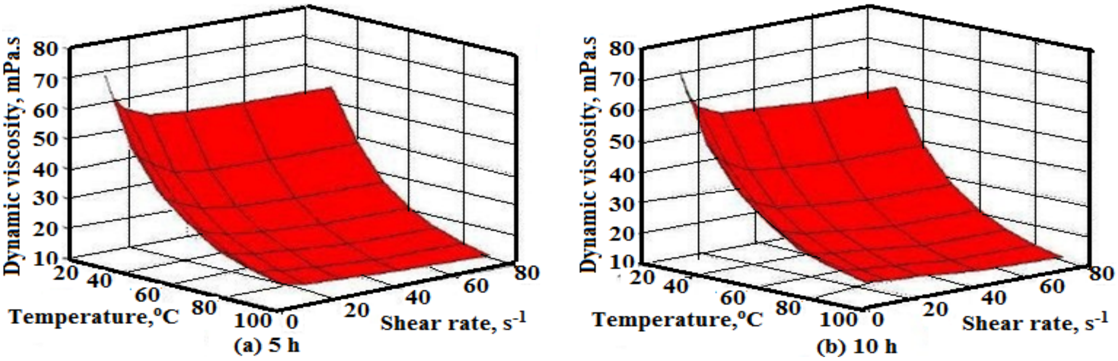

Fig. 4. Impact of temperature and shear rate on energetic thickness, for olive oil oxidized at a temperature of 120°C

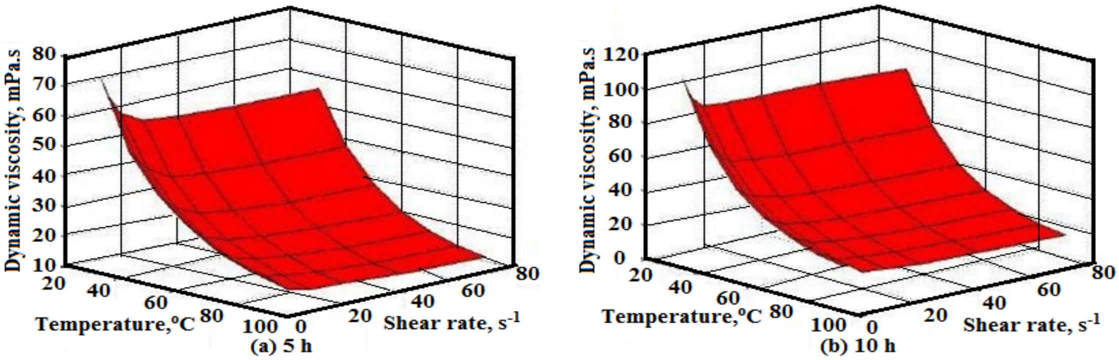

Fig. 5. Impact of temperature and shear rate on energetic thickness, for olive oil oxidized at a temperature of 130°C

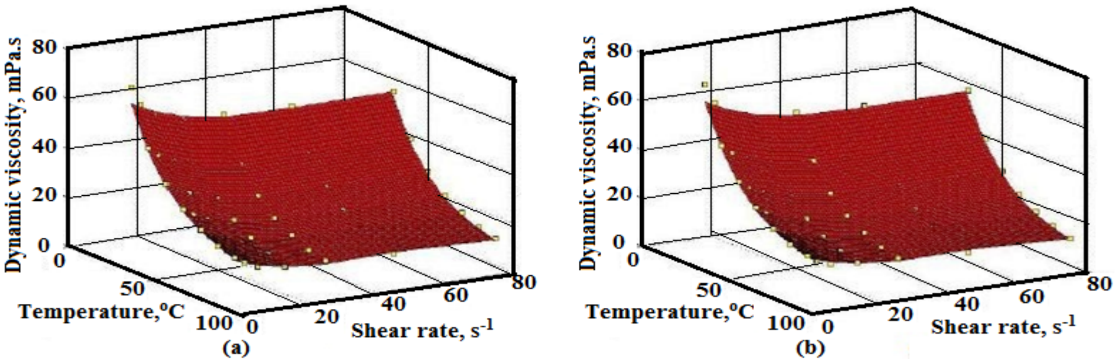

Fig. 6. Numerical modeling of the test comes about for olive oil oxidized for 5 h (a) and 10 h (b), at a temperature of 120°C

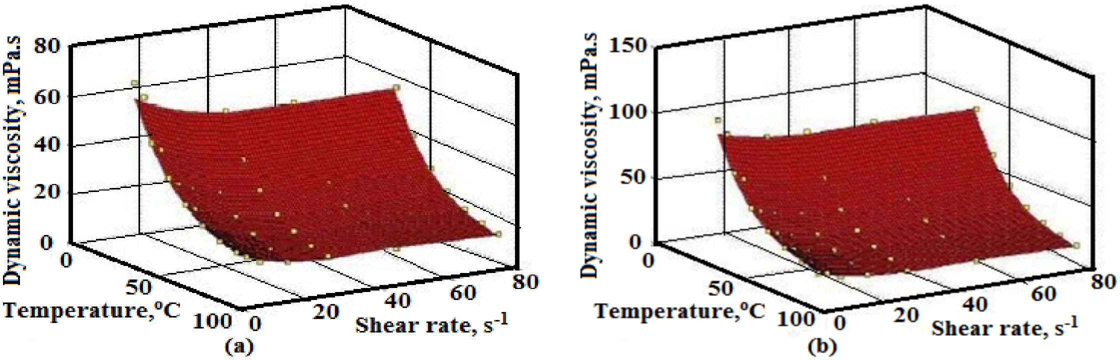

Fig. 7. Numerical modeling of the test comes about for olive oil oxidized for 5 h (a) and 10 h (b), at a temperature of 130°C

CONCLUSION

The examination of the test information appeared that olive oil has the littlest increment in energetic thickness with temperature, at all speeds and temperatures at which the oils were tried. The increment within the energetic viscosity of vegetable oils within the oxidation handle can be a model for assessing the oxidation of oils, since in mechanical applications there's a require for oils with a tall degree of energetic consistency steadiness. From the information obtained from the present study, it can be concluded that olive oil incorporates a tall oxidation solidness.

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Conflict of interest

The author declare that we have no conflict of interest.

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