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Brief communication

Study of the Rheological Behavior of Olive oil at Shear Rates Between 3.3 and 120s^{-1}

IOANA STANCIU

University of Bucharest, Faculty of Chemistry, Department of Physical Chemistry,
4-12 Elisabeta Blvd, 030018, Bucharest, Romania.

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ABSTRACT

Olive oil is a vegetable oil used mainly in the culinary field, which is extracted from freshly harvested olive fruits (*Olea europaea*). It is the richest source of monounsaturated fats. Its uses are varied, being used in cooking, in cosmetics, medicines and soaps, and in the past as lamp oil. This article presents the experimental research carried out in order to quantify the change in the rheological properties of Olive oil and establish the variation range of the characteristic parameters. The data obtained are useful for the behavior of the engine and, in particular, of lubricants in general.

Keywords: Rheology, Olive oil, Shear rate, Dynamic viscosity.

INTRODUCTION

Olive oil is a vegetable oil used mainly in the culinary field, which is extracted from freshly harvested olive fruits (*Olea europaea*). It is the richest source of monounsaturated fats. Its uses are varied, being used in cooking, in cosmetics, medicines and soaps, and in the past as lamp oil. It is used all over the world, but it is in most cases associated with the Mediterranean countries, where its production is an old tradition[1-9].

It is considered a healthy food because it energizes the heart and lowers cholesterol.

The uses of oils are numerous: in the diet a large part of the production of oils (so-called edible oils) is used, but large quantities of oils are used for industrial purposes (both as lubricants for moving mechanisms, but also as raw materials for a wide range of products in the category of consumer goods-body care substances, miscellaneous household goods). Especially castor oil has special medicinal properties and is especially valuable for a wide range of uses in dermatology and skin care in general. The ritual uses of oil are ancient, having an important place in all religions-for Christians, the triad of natural products on which much of the religious practices are based is composed of oil, wheat and wine. For several decades there has been a dispute over the use of agricultural resources as substitutes for petroleum products, which are non-renewable, more precisely, the use of vegetable oils as biofuel is encouraged; The dispute is between those who claim that in this way future generations will be left with non-recyclable natural resources, on the one hand, and those who consider the use of agricultural resources for cars a luxury and ignore the famine in which hundreds of millions are struggling, of human beings, on the other hand; the former also add that oil, compared to gasoline or diesel, is a practically safe fuel for handling, use and storage[10-17].

MATERIAL AND METHODS

Viscotester Haake VT 550 developing shears rates ranging between 3 and 1312 s^{-1} and measuring viscosities from 10^4 to 10^6 mPa*s when the HV1 viscosity sensor is used.

The rheological properties of the tested olive oil refer to: the variation of shear rate with shear stress; dynamic viscosity variation with shear rate, parameters of the considered rheological model; the variation of viscosity with temperature.

The experimental determinations were made under the following conditions:

- the shear speeds are between 3.3 and 120 s^{-1};
- the temperature range is between 40 and 100°C

RESULTS AND DISCUSSION

Figures 1 show that the relationship between shear stress and shear rate for Olive oil is always linear at all temperatures. This is another indication of the Newtonian behavior of the Olive oil samples as indicated by the simplest equation of Newton's law of dynamic viscosity.

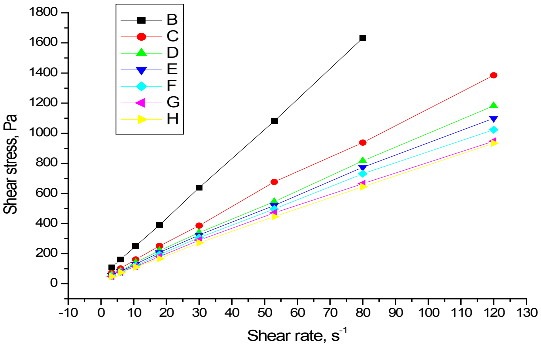

Fig. 1. Dependence of the shear rate on the shear stress at the following temperatures: B-40°C, C-50°C, D-60°C, E-70°C, F-80°C, G-90°C and H-100°C

Figures 2 and 3 show the dependence of dynamic viscosity with shear rate at different temperatures between 40 and 60°C due to the formation of the drops of Olive oil.

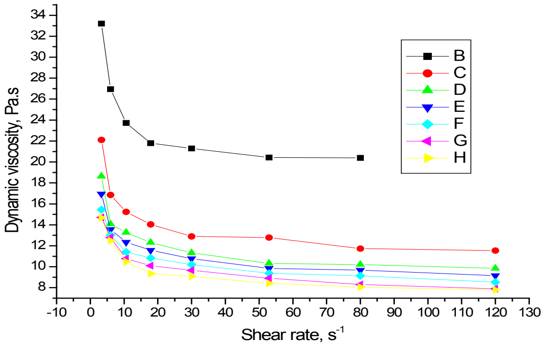

Fig. 2. Dependence of dynamic viscosity vs. shear rate at the following temperatures: B-40°C, C-50°C, D-60°C, E-70°C, F-80°C, G-90°C and H-100°C

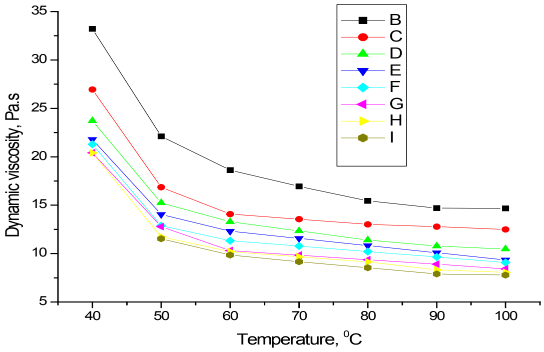

Fig. 3. Dependence of dynamic viscosity vs. temperature on the following shear rates: B-3.3 s^{-1}, C-6 s^{-1}, D-10.6 s^{-1}, E-17.87 s^{-1}, F-30 s^{-1}, G-52.95 s^{-1}, H-80 s^{-1}, I-120 s^{-1}

Figures 4 and 5 present the dependence natural logarithm of dynamic viscosity with temperature and natural logarithm of dynamic viscosity (lnη) vs. reciprocal temperature (1/T), for the shear speeds of 3.3 s^{-1}, 6 s^{-1}, 10.6 s^{-1}, 17.87 s^{-1}, 30 s^{-1}, 52.95 s^{-1}, 80 s^{-1} and 120 s^{-1}.

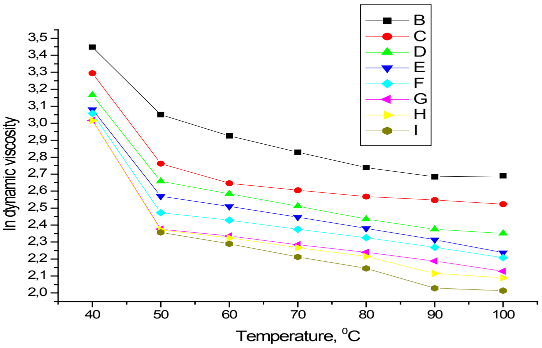

Fig. 4. Dependence on natural logarinthm dynamic viscosity vs. temperature at the following shear rates: B-3.3 s^{-1}, C-6 s^{-1}, D-10.6 s^{-1}, E-17.87 s^{-1}, F-30 s^{-1}, G-52.95 s^{-1}, H-80 s^{-1}, I-120 s^{-1}

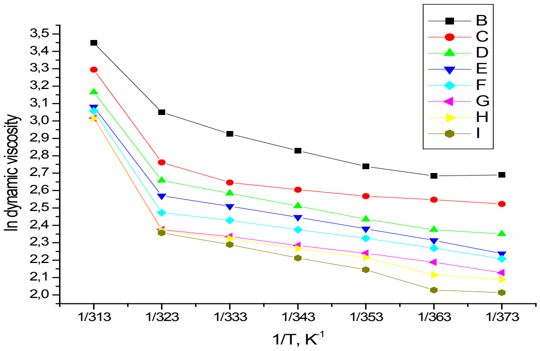

Fig. 5. Dependence on natural logarinthm dynamic viscosity vs. reciprocal temperature at the following shear rates: B-3.3 s^{-1}, C-6 s^{-1}, D-10.6 s^{-1}, E- 17.87 s^{-1}, F-30 s^{-1}, G-52.95 s^{-1}, H-80 s^{-1}, I-120 s^{-1}

CONCLUSION

The analysis of the experimental data showed that Olive oil has the smallest increase in dynamic viscosity with temperature, at all shear speeds and temperatures at which the oil was tested. The increase in the dynamic viscosity of the Olive oil can be a criterion for assessing the oxidation of the oil, because in industrial applications there is a need for oils with a high degree of dynamic viscosity stability.

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