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Brief Communication

Effect of Temperature on Rheology of Corn (Zea mays) oil

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ABSTRACT

Corn must go through a complex refining process to produce corn oil. This process gives corn oil many unique characteristics, although not all of them are positive. Corn oil is 100% fat, with no protein or carbohydrates. One tablespoon (15 mL) of corn oil contains: calories: 122; fats: 14 g and vitamin E: 13% of the recommended daily intake. This article represents the dependence of dynamic viscosity on temperature for Corn oil. It was studied with the Rheotest VT 550 system at shear rates and increasing temperatures.

Keywords: Rheology, Temperature, Corn oil.

INTRODUCTION

Corn (*Zea mays*) kernels have been used since ancient times in food, both for humans and animals.

Maize is the seed of a plant that is native to Central America but is widely cultivated around the world and has numerous health benefits. However, many controversies are also related to corn. In addition, the corn crop is often genetically modified. Maize is a cereal originally from Central America cultivated today in many regions of the world as a food, industrial and fodder plant, it represents, together with wheat, 80% of cereal production. Maize belongs to the Poaceae family. It has a tall, thick, unbranched stem, which is popularly called "cocean", with long, pointed, rough leaves.

Female flowers and male flowers are found on the same plant on the same stem. The male flowers are found at the top of the stem. The inflorescence is in the form of a spike or panicle. The female flowers are found on the underside of the leaves. Although some varieties of corn can grow up to 7 meters in height, commercial corn is grown to a maximum height of 2.5 meters. Sweet corn is usually shorter than field corn varieties.

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Corn is high in carbohydrates and full of fiber, vitamins and minerals. It is also relatively low in protein and fat[1-5].

Commercial lubricants based on vegetable oils are added, sometimes mixed with mineral oils, to minimize disadvantages such as low oxidation stability, aging, high freezing point, but additives are also added to improve the viscosity index. The selection of such a lubricant must be made after consulting the specialized literature, the product catalog, after evaluating the tests to which the fluid was subjected. It seems like a larger amount of information than conventional lubricants, but the effort is worth it, especially if the solution offers environmental protection, non-toxicity to the processed product and satisfactory rheological properties[6-13].

MATERIAL AND METHODS

Viscosity dynamic of Corn oil was determined with the help of a Rheotest VT 550 system, shear rates ranging between 3.3 s^{-1} and 120 s^{-1}, the test temperatures being between 40°C and 100°C (determinations were done for each step of 10°C, in this range).

RESULTS AND DISCUSSION

The research and testing of Corn oil is based on the methods used for conventional lubricants. Fig. 1, 2, 3 and 4 show the evolution of dynamic viscosity as a function of shear rate and temperature; the viscosity variation in a narrow range for the tested oil indicates that vegetable oils can compete with conventional ones, for applications where there is no risk of exceeding the parameters for which the evolution of the lubricant's characteristics is known. The tests were done using a viscometer with a rotating inner cylinder. Additional tests on tribomodels are required to evaluate the behavior under load.

Another limiting characteristic for Corn oil is its chemical reactivity with the materials it comes into contact with, especially plastics (including elastomers), steels, and copper and aluminum alloys. The first generations of oils obtained from rapeseeds were not performing well due to instability during oxidation, with the formation of muddy deposits at high temperatures, gelation and loss of fluidity at low temperature[13-15].

Vegetable oils with rheological properties have the great disadvantage that at high temperatures they decompose, forming fatty acids that attack the friction surfaces. In the presence of air, they are sicative (dry), resulting in a thin and resistant film, which is difficult to remove fom surfaces[15-19].

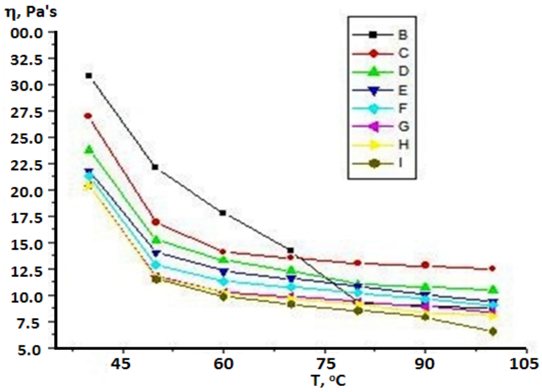

Fig. 1. The shape of the graph shows $\eta = f(t)$ for Corn oil at shear rate B-3.3 s^{-1}, C-6s^{-1}, D-10.6 s^{-1}, E-17.87 s^{-1}, F-30 s^{-1}, G-52.95 s^{-1}, H-80 s^{-1} and I-120 s^{-1}

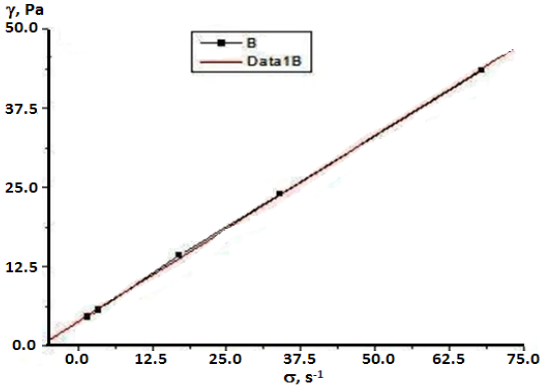

Fig. 2. The shape of the graph shows dependence shear stress (γ) vs. shear rate (σ) of Corn oil

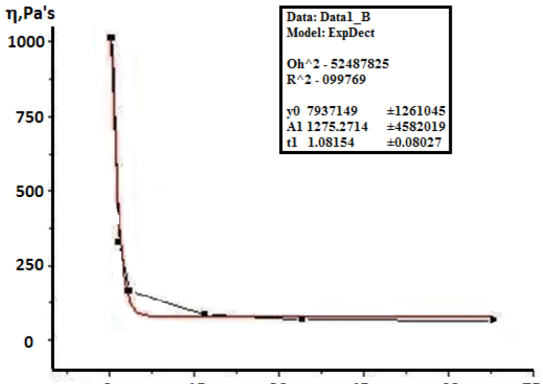

Fig. 3. The shape of the graph shows dependence dymnamic viscosity vs. shear rate $\eta = f(\sigma)$ for Corn oil

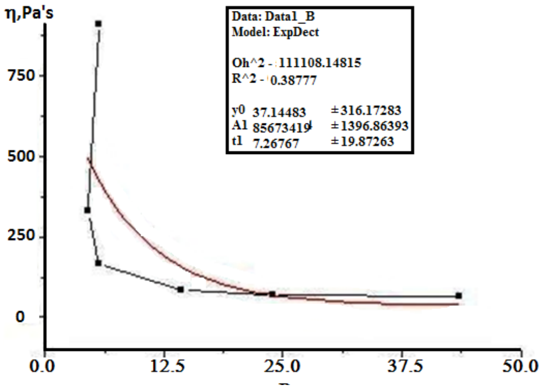

Fig. 4. The shape of the graph shows dependence dynamic viscosity vs. shear stress $\eta = f(\gamma)$ for Corn oil

CONCLUSION

The plotted graphs show an exponential dependence of temperature on shear rates, shear stress and dynamic viscosity of corn oil. It was studied at increasing temperatures and shear rates, while the dynamic viscosity decreases exponentially.

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Conflict of interest

The author declare that we have no conflict of interest.

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