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Brief communication

Rheology of Cottonseed *(Gossypium hirsutum)* oil Used as Biodegradable Lubricant

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ABSTRACT

Vegetable oils are often associated with well-known varieties like sunflower, olive, and corn. However, there are lesser-known options worth exploring to appreciate their distinct qualities. One such overlooked oil is cottonseed oil, derived from the Malvaceae cotton family plant. In a recent study, we delved into the rheological behavior of cottonseed oil. Similar to many vegetable oils, it exhibits a non-Newtonian behavior, making it a viable alternative to mineral oils. The rheological analysis was conducted using the Brookfield RVDV III Ultra Rheometer, with shear rates incrementally increasing.

Keywords: Rheology, Cottonseed, Oil, Non-Newtonian, Behavior

INTRODUCTION

Many vegetable oils, but usually associate with them only the main-sunflower, olive, corn. But there are other types, less common, that you should definitely try one to appreciate their unique properties. One of these obscure vegetable oils is cottonseed oil. The name goes back to the plant from which the oil is extracted-the Malvaceae cotton family[1-5].

For the production of cotton seeds only oils are used that do not contain more than 25% of oil in its composition, and rolled it is possible to extract only 18%. However, the production of cottonseed oil cannot be called uneconomic, because, in fact, it is produced from the processing of mass waste from cotton-the textile industry. Thus, separating the seeds from linters Linter, exfoliated them by ovens heated to 220 degrees and oil presses and then it is drained.

The oil can be found in different colors in the market. Brown shades are inherent in unrefined cottonseed oil, which is not used in food products, for medical and cosmetic purposes, because it contains harmful substances. cheaper unrefined oil, it is mainly used for the production of olives, soap, vegetable stearin. Refined oil also undergoes additional purification, after which it acquires a light shade. It is virtually odorless, making it ideal for cooking and scented cosmetic bases. Also with margarine or the participation of products and mixed vegetable oils. Despite the exoticism of cottonseed oil in our latitudes, it is quite popular in their homeland in Central Asia, where it is used as universally as sunflower.

The chemical composition of cottonseed oil varies slightly depending on the type and place of cotton cultivation. Approximately 60% are phytosterols, and another 30% - tocopherols. The composition of fatty acids include stearic, arachidic, palmininovaya, myristic, oleic and linoleic acid[6-10].

No product that has no contraindications, due to possible allergic reactions to any of the components. Apply it to cottonseed oil. You should also carefully consider the choice of oil: use for domestic and medicinal purposes can only be refined, which, in addition to the label, can be determined by light shades. Gossypol cotton is present as part of the crude oil the pigment that gives the crude oil its characteristic brown color. Gossypol suppresses spermatogenesis and can affect the reproductive function blocks the activity of enzymes involved in the body's metabolism. And although it is now for gossypol and found an active anti-tumor effect, the study of this issue is not finished yet. Maybe in the future cotton gossypol and will be a panacea for incurable diseases, but today it must be treated with caution, because randomly exceeding the maximum dose can lead to serious poisoning or death. Gossypol removed during the refining of cottonseed oil, so that the oil in a purified form is harmless.

Cotton seed oil has the ability to inhibit cholesterol shelves on the vessel walls. The use of cottonseed oil is that immunity is increased when used regularly. This product is widely applied in the fight against hyperglycemia, allergies and dermatological rashes. cottonseed oil very useful in the treatment of skin burns. Gossypol, which is part of the oil, does not allow the virus to spread in the blood.

Cotton seed oil - an excellent alternative to walnut. This is especially important for those who are allergic to peanut butter. The fatty acid content of cottonseed oil makes this product indispensable for people suffering from gastric ulcers.

Cotton seed oil known in cooking and cosmetology. It helps in the fight against dry aging and skin changes, and makes the hair shiny and silky. In addition, very often cottonseed oil is added to soap making[10-15].

MATERIAL AND METHODS

This cottonseed oil was studied with the Brookfield RVDV III Ultra Rheometer at shear rates between 60 and 105s^{-1} and shear stresses between 35.1Pa and 60.9Pa. The cottonseed oil has viscosities between 58.7 mPa.s and 58 mPa.s.[10]

RESULTS AND DISCUSSION

Figure 1 shows the linearization of the experimental data of the oil cottonseed. The oil has a non-Newtonian behavior in the temperature range at which it was studied and increasing shear speeds.

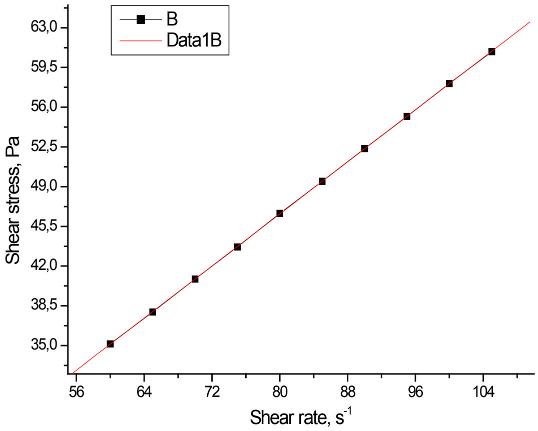

Fig. 1. Linearization of the experimental data of the oil cotton seed at temperature 40°C

Figure 2 shows the dependence exponential of the dynamic visxcosity vs. shear rate on cotton seed oil. The graph shows an exponential decrease in dynamic viscosity with shear rate. At high shear rates the dynamic viscosity of the cottonseed oil becomes almost constant.

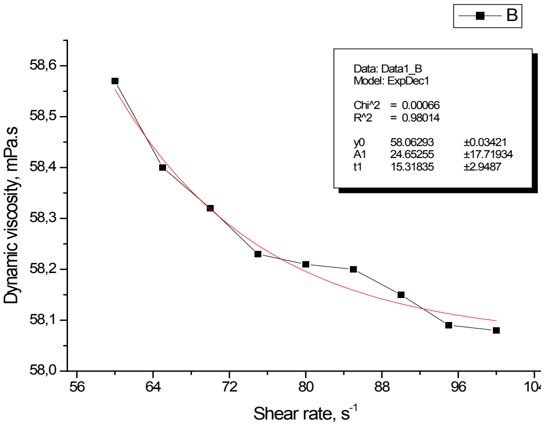

Fig. 2. Exponential dependence dynamic viscosity vs. shear rate at temperature 40°C

The dependence exponetial of dynamic viscosity on temperature is described by equation (1). The correlation coefficient has a value close to one.

$$\eta = \eta_0 + A_1 \exp(-\dot{\gamma} / t_1) \quad (1)$$

Where η_o= 58.06293, A_1 = 24.65255 and t_1 = 15.31835 R^2 = 0.98014.

Figure 3 shows the dependence of the dynamic viscosity on the shear stress for cottonseed oil. The graph shows a decrease in dynamic viscosity with shear stress at the temperatures at which the oil was studied.

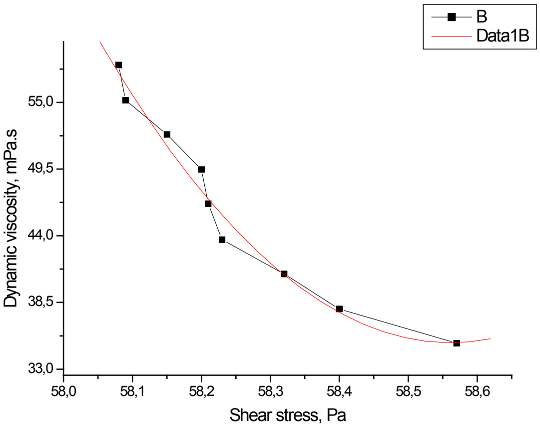

Fig. 3. Dependence dynamic viscosity on shear stress at temperature 40°C

The dependence of the dynamic viscosity on the shear stress is described by equation (2). The values of parameters A, B1 and B2 faithfully describe the non-Newtonian behavior of cotton seed oil and the correlation coefficient has a value close to one.

$$\eta = A + B_{1\tau} + B_{2\tau}^{2} \quad (2)$$

Where A = 329137.09976 B_1= -11239. 58687 B_2 = 95.96443 R^2 = 0.97866.

Figure 4 shows the temperature dependence of the dynamic viscosity for cottonseed oil on the shear rates at which the oil was studied. As can be seen from the graph, the dynamic viscosity of cottonseed oil decreases with increasing temperature.

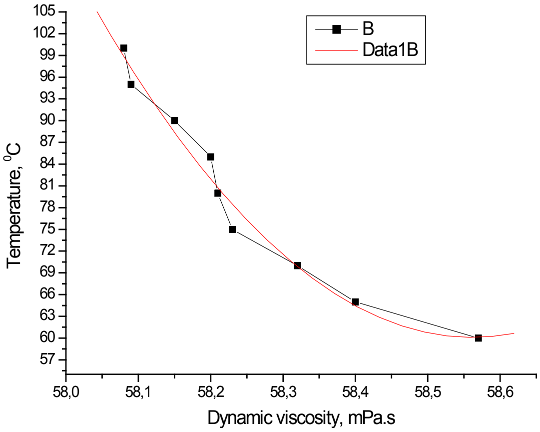

Fig. 4. Dependence temperature vs, dynamic viscosity

CONCLUSION

The biodegradable oil based on cottonseed oil show a great interest lately talking into consideration theenvironmental protection. The properties (characteristics) of the biodegradable cottonseed oil are comparable to in some cases even better than the mineral oils used for the some applications.

From the personal researches regarding one the rheological parameters of the studied cotton seed oil (viscosity) results that the most favourable behaviour for the biodegradable lubricants.

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Conflict of interest

The author declare that we have no conflict of interest.

REFERENCES

1. Cherry J.P., *Journal of the American Oil Chemists' Society.*, **1983**, *60*(2Part2), 360-367.
2. Stanciu I., *Journal of Science and Arts.*, **2019**, *3*(48), 703-708.
3. Rashid U.; Anwar F., & Knothe G., *Fuel Processing Technology.*, **2009**, *90*(9), 1157-1163.
4. Stanciu I., *Journal of Science and Arts.*, **2019**, *4*(49), 938-988.
5. Saxena D.K.; Sharma S.K., & Sambi S. S., *ARPN Journal of Engineering and Applied Sciences.*, **2011**, *6*(1), 84-89.

6. Sekhar S. C.; Rao B. V. K., *Pertanika J. Trop. Agric. Sci*., **2011**, *34*(1), 17-24.
7. Bhattacharjee P.; Singhal R.S., & Tiwari S.R., *Journal of Food Engineering*., **2007**, *79*(3), 892-898.
8. Dinda S.; Patwardhan A.V.; Goud V.V.; Pradhan N.C., *Bioresource Technology*., **2008**, *99*(9), 3737-3744.
9. Karabektas M.; Ergen G.; Hosoz M., *Applied Thermal Engineering*., **2008**, *28*(17-18), 2136-2143.
10. Stanciu I.,*Journal of Science and Arts*., **2011**, *1*, 55-58.
11. Meneghetti S.M.P.; Meneghetti M.R.; Wolf C.R.; Silva E.C.; Lima G.E.; Coimbra M.D. A.; Carvalho, S.H., *Journal of the American oil chemists' society*., **2006**, *83*(9), 819-822.
12. Stanciu I., *Journal of Science and Arts*., **2018**., *18*(2), 453-458.
13. Sheibani A.; Ghotbaddini-Bahraman, N. A. S. E. R., & Sadeghi, F. A. T. E. M. E. H., *Orient, J, Chem*., **2014**, *30*(3), 1205-1209.
14. Omar M. N.; Nor N. N. M., Idris, N. A., *Orient, J, Chem*., **2009**, *25*(4), 825.
15. Audu S. S.; Aremu M. O.; Lajide, L., *Orient, J. Chem*., **2013**, *29*(3), 979-989.