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INFLUENCE TEMPERATURE AND DYNAMIC VISCOSITY OF RHEOLOGICAL BEHAVIOR FOR REFINED SUNFLOWER OIL

KEYWORDS: oil sunflower, temperature, models, viscosity

Ioana Stanciu

University of Bucharest, Faculty of Chemistry, Department of Physical Chemistry, Bvd. Regina Elisabeta

ABSTRACT *In this paper to determine two models theoretical on literature the rheological characteristics for variation dynamic viscosity with absolute temperature for refined sunflower oil. The rheological behavior of the refined sunflower oil has been studies on a Haake VT 550 viscosimeter with a HV1 sensor that provides for shear rates from 3 to 1312 s-1 and a temperature range from 313 to 373K. The parameters A, B and C obtained by the linear fitting.*

INTRODUCTION

The variation temperature with the dynamic viscosity for refined sunflower oil is the phenomenon by which liquid viscosity tends to decrease as its temperature increase [1-4].

A molecular view of liquids (refined sunflower oil) can be used for a qualitative picture of the process of decrease in the shear rate (or bulk) dynamic viscosity of with temperature. As the temperature increases, the time of interaction between neighboring molecules of oil decreases because of the increased velocities of individual molecules. The macroscopic effect is that the intermolecular force appears to decrease and so does the bulk (or shear rate) dynamic viscosity [5-7]. The actual process can be quite complex and is typically represented by simplified mathematical or empirical models, some of which are discussed below [8-10]. The theoretical models rheological are valid over limited temperature ranges and for selected materials [11-13].

In this paper presents two theoretical models rheological for refined sunflower oil used as a biodegradable lubricant.

MATERIAL AND METHOD

The refined sunflower oil was purchased from the Ulerom SA Romania from a specialized distribution chain. To study the rheological behavior of the oil it was used viscosimeter Haake VT 550 equipped with HV_1 sensor. For the rheological study the was tested refined sunflower oil. The dynamic viscosity was determined for shear rates range 3.3 to 120 s^{-1} and the temperature range from 313 and 373K.

RESULTS AND DISCUSSION

Figures 1 and 2 shows variation ln dynamic viscosity with inverse temperature squared for the shear rate for refined sunflower oil.

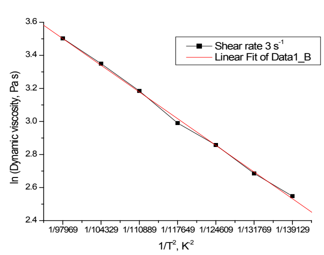

Figure 1: Variation of ln dynamic viscosity with inverse temperature squared at shear rate 3 s^{-1}

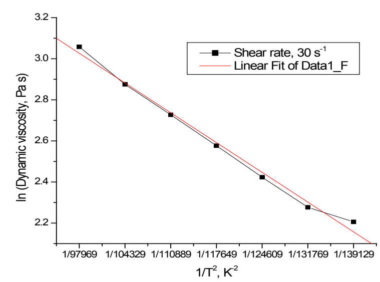

Figure 2: Variation of ln dynamic viscosity with inverse temperature squared at shear rate 30 s^{-1}

The equation that describes the ln dynamic viscosity inverse temperature squared of dependence for of the refined sunflower oil studied is (1):

$$\ln h = A + B/T + C/T^2 \quad (1)$$

where T is the temperature absolute and A, B and C in the equations (1) are correlation constants. The results of regression analyses to these relations are presented in Tables 1.

There was calculated the line equation, that fits better to experimental data and there were determined the line parameters, *A, B* and *C*, the line slope reflecting the behavior of the ln dynamic viscosity versus inverse temperature squared [12-15].

In Tables 1 present the values of the constants A, B and C as well as correlation coefficients, R^2 empirical relations (1).

TABLE – 1
VALUES OF PARAMETERS OF THE THEORETICAL MODELS DESCRIBED BY EQUATION (1) AND THE STANDARD ERROR OF REGRESSION ANALYSIS, R^2

Shear rate, s-1	Equation (1)			
	A	B	C	R^2
3.3	3.6625	2.5197	0.1614	0.9992
6	3.3707	2.0283	0.1402	0.9903
10.6	3.2293	1.9884	0.1352	0.9839
17.87	3.1598	2.2789	0.1411	0.9888
30	3.1718	2.3967	0.1449	0.9958
52.95	3.1692	2.6264	0.1513	0.9992
80	3.1160	2.6887	0.1512	0.9977
120	2.4732	0.0481	0.0615	0.9987

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The Table 1 shows that the parameter A goes down with the increase in the shear rate and in the temperature. The parameter B goes down with the increase in the shear rate of the refined sunflower oil.

The parameter C displays a positive value for refined sunflower oil at the shear rate range of 3.3 and 120 s^{-1}. The correlation coefficients are close to one over the shear rate range of 3.3 and 120 s^{-1}.

The Figure 3 shows variation ln dynamic viscosity with inverse temperature for shear rate range of 3.3 s^{-1}.

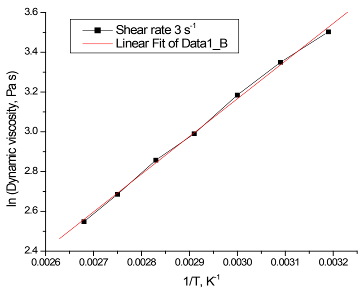

Figure 3: Variation of ln dynamic viscosity with inverse temperature at shear rate 3 s^{-1}

The analysis ln dynamic viscosity versus inverse temperature is obtained the equation

$$\ln h = A + B/T + CT \qquad (2)$$

where T is the temperature absolute and A, B and C in the equations (2) are correlation constants. The results of regression analyses to these relations are presented in Tables 2.

In Tables 2 present the values of the constants A, B and C as well as correlation coefficients, R^2 empirical relations (2).

TABLE – 2
VALUES OF PARAMETERS OF THE THEORETICAL MODELS DESCRIBED BY EQUATION (2) AND THE STANDARD ERROR OF REGRESSION ANALYSIS, R^2

Shear rate, s-1	Equation (2)			
	A	B	C	R^2
3.3	8.5516	2.5197	0.0161	0.9992
6	7.6188	2.0283	0.0140	0.9903
10.6	7.3249	1.9884	0.0135	0.9839
17.87	7.4352	2.2789	0.0141	0.9888
30	7.5632	2.3967	0.0145	0.9958
52.95	7.7538	2.6264	0.0151	0.9992
80	7.6972	2.6887	0.0151	0.9977
120	4.3355	0.0481	0.0062	0.9987

The Table 2 shows that the parameter A goes down with the increase in the shear rate and in the temperature. The parameter B goes down with the increase in the shear rate of the refined sunflower oil. The parameter C displays a positive value for refined sunflower oil at the shear rate range of 3.3 and 120s^{-1}. The correlation coefficients are close to one over the shear rate range of 3.3 and 120 s^{-1}.

Equations (1) and (2) are suitable for describing the temperature dependence of dynamic viscosity of refined sunflower oil as correlation coefficients are close to the value 1.

CONCLUSIONS

In this paper was studied variation viscosity with temperature for refined sunflower oil. It was observed that viscosity decreases as temperature increases for all refined sunflower oil analyzed at all four shear rates at which determinations were made. The equations that best describe the temperature dependence of dynamic viscosity of sunflower oil (1) and (2) because the correlation coefficients are close to one.

The dynamic viscosity sunflower oil decreases exponentially with increasing temperature and shear rate. Plotting the log of the inverse dynamic viscosity depending on temperature shows a linear decline.

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