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Methods of Determination Viscosity Index for Sunflower oils

Chemistry

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ABSTRACT

In this article we presented viscosity index for sunflower oil using three method. Viscosity index are calculated from the measured viscosity at 40 and 100oC according to ASTM D 2270, using program VI and graphical method from ASTM D 341. The viscosity-temperature coefficients for sunflower oil were calculated from the measured viscosity at 40 and 100oC.

INTRODUCTION

The parameter expressing the temperature-viscosity oil is traditionally viscosity index. Viscosity Index is an empirical dimensionless number that indicates the extent to which the kinematic viscosity of oil changes with temperature in a given range, high value means small change in viscosity with temperature and low value - high variation. [1] After the value of viscosity oils are classified into four categories: small index - less than 35, medium - between 35 and 80, high - between 80 and 110 and very high - as high as 110. Determination of the viscosity of sunflower oil was carried out by comparing the initial kinematic viscosity of the oil found in the 40°C kinematic viscosity of the second reference oil is one which has 100 IV 0 and the other at the same temperature, both with the same kinematic viscosity at 100oC for given oil. For a long time, however, it is used to determine the kinematic viscosity of the oil gave 40 and 100oC, values that are inserted into the charts developed by the American Society for Testing and Materials and covered by ASTM 2270-04, for calculating viscosity index of petroleum products (such as lubricants) and the related materials thereof [2-4] .

Viscosity-temperature charts were developed based on empirical equation Walther relationship between kinematic viscosity and temperature:

$$\log \log (\nu + 0{,}7) = A + B \log T \qquad (1)$$

- kinematic viscosity, T - K temperature, and A and B – oil specific constant. Such diagrams allow plotting temperature kinematic viscosity data in the form of straight petroleum oils can be applied to the entire temperature range in which liquid oils are homogeneous [5-7]. Individual diagrams are drawn different temperature areas covering - together - kinematic viscosity between 0.18 and 2.107 cSt and temperatures from (-70) to 370oC. IV is calculated from kinematic viscosity at 40oC of the three oils, reference and whose index must be determined using - ASTM D 2270-04 – relationship (2):

$$IV = 100 \times (L - U)/(L - H) \qquad (2)$$

wherein U is the viscosity of the oil, L - the oil with the H IV 0 - IV oil with 100. The relationship is used to determine the viscosity index of the oil with values less than or equal to 100, where the value of U is between L and H. For oils that are less than the H value of U, the situation encountered in the oil with IV greater than 100, to define a parameter N, the value of Y calculated from the H and the kinematic viscosity at 100oC to give oil and IV is given by the equation (3):

$$IV = 100 + 140((\text{antilog } N) - 1 \qquad (3)$$

where

$$N = (\log H - \log U)/\log Y \qquad (4)$$

Values Y, L and H are tabulated in ASTM D 2270 for Y between 2.0 and 70.0 cSt. Although viscosity index describes the physcal behavior of oil, it does not fall into the category of physical properties. If used to indicate the type of hydrocarbon solvent power, compatibility with elastomers, etc., or select additives to improve IV, it can give erroneous results. The most convenient way to determine the kinematic viscosity at temperatures other than those indicated, or to determine the viscosities at 40 and 100oC the viscosity at other temperatures is graphically charts using ASTM D 341. Determination of the viscosity is reduced to finding two standard viscosity temperatures to a temperature and IV [8]. To calculate the viscosity index we used a program viscosity index acc ISO 2909 / ASTM D 2270 on http://www.tribologyabc.com/calculators/astm_d2270-226.htm using kinematics viscosity at 40oC and 100oC [9]. The objective of the present paper is the determination of viscosity index of a sunflower oil for tree methods: calculated from the measured viscosity at 40 and 100oC according to ASTM D 2270, using program VI and graphical method from ASTM D 341.

MATERIALS AND METHOD

The vegetable oils used for this work is sunflower oil. The fatty acid composition in weight percentage of sunflower oil is: monounsaturated 23 %, polyunsaturated 65 % and saturated 12 % [10, 11]. The kinematic viscosity is measured following the established procedure in the ASTM D 445. The dynamic viscosity of the sunflower oil is determined with calibrated Schott Ubbelohde-type viscometers at temperatures 40 and 100oC. The viscometer is placed in a temperature controlled vessel equipped with a thermostat which maintained the temperature with an accuracy of ±0.1. The temperature erorr in viscosity determination is less than 0.5 %. Density and temperature is measured using a 25oC pycnometer immersed in a temperature – controlled circulating water bath. The kinematic viscosity values at each temperature are determined by multiplying the measured flow time on the oil through the viscometer capillary with a callibration constant [12].

RESULTS AND DISCUSSION

Viscosity is a measure of an oil thickness and ability to flow at certain temperatures, while viscosity index is a lubricating oil quality indicator, an arbitrary measure for the change of its kinematic viscosity with temperature and provides an insight into the oil's ability to perform at high and low temperatures [13-17]. The viscosity index of the sunflower oil determined with equation (2) was 163.22. The kinematic viscosity of the sunflower oil was 7.78 cSt at 100°C and 33.21 cSt at 40°C. The viscosity index of sunflower oil was determined using the ASTM D 341 diagram, shown in Fig. 1. The value obtained for the viscosity index of sunflower oil together with its kinematics viscosities at 40 and 100°C and viscosity-temperature are presented in table 1. The density oil sunflower is 0.9320 $g.cm^{-3}$.

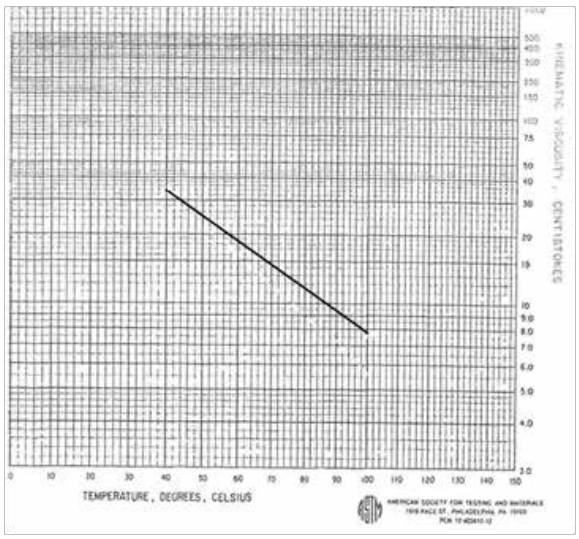

Figure 1: Diagram ASTM D 341 for the determination of the VI viscosity index of sunflower oil

The value obtained for the viscosity index of sunflower oil in table 1 and viscosity-temperature coefficient.

Viscosity index of the sunflower oil obtained with the software is 53.77 times lower than that obtained with equation (2) but is still at the standard ASTM 2270.

TABLE – 1
VALUE OF VISCOSITY INDEX AND VISCOSITY-TEMPERATURE COEFFICIENT FOR SUNFLOWER OIL

Oil	Viscosity index calculated with eq. (2)	Viscosity index from program VI	Viscosity temperature coefficient calc. with eq. (6)
sunflower	163.22	216.99	0.7657

Viscosity-temperature coefficient is defined by (5):

$$VTC = (A - B)/A \quad (5)$$

where A is the viscosity (cSt) at 40°C and B – viscosity at 100oC. The value of this coefficient is lower, the oil behavior is better when compared with the same viscosity oils. The calculated values of VTC are also given in Table 1.

CONCLUSIONS

The viscosity of sunflower oil was determined using tree methods: ASTM D 2270 and method graphically using ASTM D 341. Viscosity index calculation was performed with a computer program using kinematic viscosity at 40oC and 100oC. Viscosity index of sunflower oil obtained with equation (2) is 53.77 times lower than that obtained with the software but is still at the standard ASTM 2270. The viscosity-temperature coefficient for sunflower oil can vary by a factor of 10 depending on the temperature. The viscosity of sunflower oil is dependent upon temperature. Viscosity decreases as temperature increases because the molecules vibrate more, and interact less.

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