***ORIGINAL PAPER***

# VISCOSITY INDEX OF RAPESEED OIL

IOANA STANCIU[1]

*Manuscript received: 10.07.2011; Accepted paper: 02.09.2011;*

*Published online: 01.12.2011*

**Abstract.** *In this paper were determined viscosity index of rapeseed oil using two methods. Viscosity index is calculated from the measured viscosity at 40 and 1000C using ASTM D 2270 and method graphically using ASTM D 341. The viscosity-temperature coefficient of rapeseed oil was calculated from the measured viscosity at 40 and 1000C.*

**Keywords:** *viscosity index, viscosity-temperature coefficients, rapeseed oil.*

## 1. INTRODUCTION

As the uppermost herbaceous edible oil crop in Romania, rape (*Brassica Napus*) has been planted for thousands of years. The rapeseed oil extracted from the rape seed is top-quality edible oil, which contains rich fact acids, fast-soluble vitamins, phospholipids and pigments but lacks cholesterol [1]. The color of rapeseed is deep yellow. The characteristic of large viscosity, least saponification value among semi-drying oils and high-content erucic acid can be used to distinguish rapeseed oil from other vegetable oils [2, 3].

Viscosity index, or IV, is a means of expressing the variation of viscosity with temperature. IV is also widely used as a rough measure of the paraffinic of naphthenic hydrocarbon character of oil. In this context, mid-IV or high-IV has connotations that suggest good or poor solvent power for additives or tendency to swell or shrink certain elastomers. Most recently, hydrocarbon type, along with manufacturing history, has been used to classify oils with respect to health hazards, particularity carcinogenicity.

Viscosity index is calculated from the measured viscosity at 40 and $100^0$C using ASTM Method D 2270, by reference to two series of no longer existent oil. It is one of the most awkward possible ways to express the type of information it conveys, and is one of the more obvious demonstrations of the conservatism of the petroleum and lubricant industries.

In the calculation of IV, for each viscosity at $100^0$C (called Y), the ASTM Method D 2270 gives value of two parameters, called L and H. L is the 400C viscosity of oil having the same $100^0$C viscosity as the test oil, but a IV of zero. H is the $40^0$C viscosity of second oil, also with the same $100^0$C viscosity, but with a IV of 100. Since high IV indicates a lesser change is viscosity with temperature, L is always greater than H. The IV of the oil being considered is defined by the relationship of its $40^0$C viscosity (called U) to the parameters L and H. If U is between L and H, the IV is the percent of the way U is from L to H:

$$IV=100x(L-U)/(L-H) \quad (1)$$

[1] University of Bucharest, Faculty of Chemistry, 030018 Bucharest, Romania. E-mail: istanciu75@yahoo.com

A completely different calculation is used for oils where U is less than H, which is true for oil with IV greater than 100. For these oils, the IV is defined by a new parameter N, calculated from H and Y rather than H and L:

$$IV=100+140((\text{antilog}N)-1 \quad (2)$$

$$N=(\log H-\log U)/\log Y \quad (3)$$

All logarithms are to base 10. The tables given is ASTM D 2270 provide values for Y from 2cSt to 70cSt at 1000C. Values of L and H for higher viscosities are calculated from two equations:

$$L=0.8385Y2+14.67Y-216 \quad (4)$$

$$H=0.1684Y2+11.85Y-97 \quad (5)$$

For Y >70.

When IV is used to indicate hydrocarbon character, the solvent power, elastomer compatibility, the use of additives to improve IV can give very misleading results. The use of IV for non-petroleum hydrocarbons or for non-hydrocarbons materials seems completely bankrupt [4, 5].

The viscosity at other temperatures may be conveniently determined graphically using ASTM D 341. Finding the viscosity at any given temperatures is then reduced to finding the viscosity at two standard temperatures from the viscosity at one temperature and the IV.

The importance of the VI can be shown by considering automotive lubricants: oil having high VI resists excessive thickening when the motor is cold, promoting rapid starting and prompt circulation, and resists excessive thinning when the engine is hot, providing full lubrication and preventing excessive oil consumption.

The object of the present paper is the determination of viscosity index for rapeseed oil.

## 2. MATERIALS AND METHOD

Vegetable oil used in this work is provided by a company in Bucharest, Romania. Viscosity index of rapeseed oil were determined using a set of Schott Ubbelohde-type viscometers selected according to the values of their constants, so that the margins of the uncertainty, inherent in the Hagebach-Couette correction, does not exceed the error allowed for the measurements. The measurements were carried out at $40\pm0.1$ and $100\pm0.1^{o}C$, according to the recommandation of ASTM D 2270 – 93 [6].

## 3. 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 kinematics viscosity with temperature and provides an insight into the oil's ability to perform at high and low temperatures.

The viscosity index of rapeseed oil were determined equation (1) is 156. The rapeseed oil was 7.51cSt viscosity at $100^0$C and 34.26cSt viscosity at $40^0$C.

The viscosity index of rapeseed oil was determined using the ASTM D 341 diagram, shown in Fig. 1.

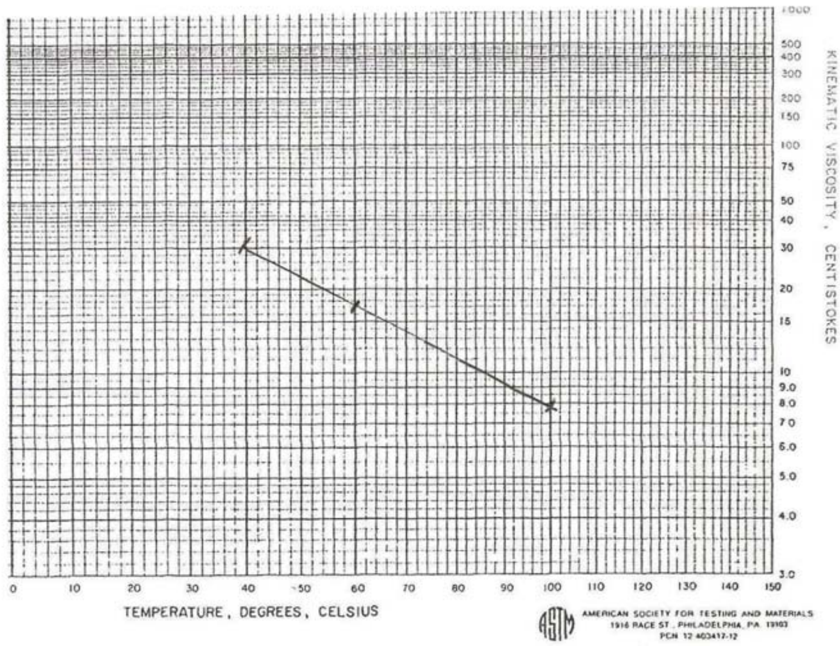


**Fig. 1. Diagram ASTM D341 for determination viscosity index of rapeseed oil.**

The value obtained for the viscosity index of rapeseed oil in table 1, together with their kinematics viscosities at 40 and $100^o$C and viscosity-temperature coefficients.

**Table1. Values of kinematics viscosities at 40 and $100^0$C, density, viscosity index and viscosity-temperature coefficient.**

| Oil | Density ($g/cm^3$) | Viscosity cinematic ($mm^2/s$) | | Viscosity index | Viscosity-temperature coefficient |
|---|---|---|---|---|---|
| | | $40^0$C | $100^0$C | | |
| Rapeseed | 0.9210 | 34.26 | 7.51 | 156 | 0.7808 |

Another indication of the change in kinematics viscosity with temperature, which is less arbitrary than the viscosity index, is the viscosity-temperature coefficient, VTC, defined by the relationship [7 - 9]:

$$VTC = (A – B)/A \quad (6)$$

where A is the viscosity (cSt) at 40oC and B – viscosity at $100^o$C. The calculated values of VTC are given also in Table 1.

## 4. CONCLUSIONS

The viscosity of rapeseed oil was determined using two methods: ASTM D 2270 and method graphically using ASTM D 341. The viscosity-temperature coefficient for rapeseed oil can vary by a factor of 10 depending on the temperature.

The viscosity of rapeseed oil is dependent upon temperature, pressure and shear rate. Viscosity decreases as temperature increases because the molecules vibrate more, and interact less.

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