КРАТКИЕ СООБЩЕНИЯ
BRIEF REPORTS — KURZE MITTEILUNGEN

A GRAPHICAL METHOD FOR DETERMINING THE COEFFICIENT OF VISCOSITY OF NON-ELASTIC LIQUIDS IV

By

ALI ABDEL-KERIM IBRAHIM (Ph. D.)

PHYSICS DEPARTMENT, FACULTY OF SCIENCE, THE UNIVERSITY, ALEXANDRIA, EGYPT

(Received: 14. I. 1958)

Consider a non-elastic liquid filling the annular gap between two coaxial cylinders. The outer be of an inner radius b in cms, and oscillating through very small amplitudes of the order of 1° with various frequencies n c. p. s. The inner of radius a in cm, moment of inertia I gm cm^2 be suspended by a torsion wire of restoring constant τ in gm cm^2 sec^{-2}.

If Θ_0 is the displacement of the inner cylinder, $\varnothing_0$ that of the outer and $\varnothing$ the phase angle by which the inner cylinder lags the outer cylinder, then, according to my theory we have [1]

$$\Psi \cos \Phi = \frac{b}{a} \frac{L_2 L + M_2 M}{L^2 + M^2} \tag{1}$$

where

$$\Psi = \Theta_0 / \Phi_0.$$

L, M, L_2 and M_2 have been given [2] in a previous paper by the author.

Equation (1) represents an exact relationship between the measured quantity $\psi \cos \Phi$ and the desired η (the coefficient of viscosity). This equation is neither simple nor direct as the Bessel function involves η.

By introducing in equation (1) a dimensionless parameter defined by

$$\sqrt{2} B a = X; \quad B = \left(\frac{\pi \varrho n}{\eta}\right)^{1/2},$$

where n is the frequency, ϱ the density and η the coefficient of viscosity of the liquid and X may take any positive value, for which in our work was chosen $x = 1$ and therefore $\sqrt{2}\, B\, a = 1$, so that $\sqrt{2}\, B\, b = 1.4$ and substituting the value of $\sqrt{2}\, Ba$ and $\sqrt{2}\, Bb$ in equation (1) we have

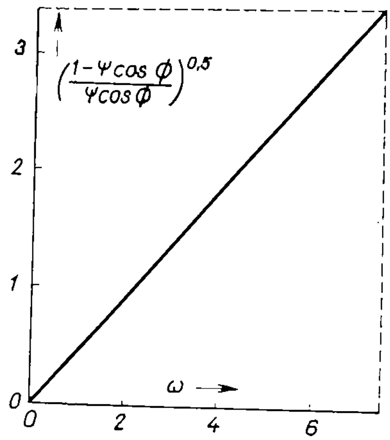
$$\left(\frac{1 - \Psi \cos \Phi}{\Psi \cos \Phi}\right)^{0.5} = 3.42\,. \tag{2}$$

By drawing a line perpendicular to the $\left(\frac{1 - \Psi \cos \Phi}{\Psi \cos \Phi}\right)^{0.5}$ axis it intersects the experimental curve at a certain angular frequency ω_s.

Hence, by substituting the value of ω_s obtained and the value of X chosen in the following relation.

$$\eta = \omega_s \varrho \left(\frac{a}{x}\right)^2$$

the value of η can be determined.



Results

The following Table gives the results derived from MARKOVITZ et al [3] for standard oil OB—5 obtained from the National Bureau of Standards. The full line in the Figure represents the variation of $\left(\frac{1 - \Psi \cos \Phi}{\Psi \cos \Phi}\right)^{0.5}$ versus ω for the respective liquid, while the dotted line shows the variation of the dimensionless parameter curve.

ω_s	η in poise	
	from exper	from a paper
760	88.92	91.6

From the Table it appears that both theory and method are satisfactory.

REFERENCES

1. A. A. K. IBRAHIM (Submitted for publication).
2. A. A. K. IBRAHIM and A. M. I. KABIEL, J. Phys. Soc. Japan, **12**, 1304, 1957.
3. H. MARKOVITZ, P. M. YAVORSKY, R. C. HARPER, Jr., L. J. Zapas and T. W. DEWITT, Rev. Sci. Inst., **23**, 430, 1952.