Journal of Engineering Physics and Thermophysics, Vol. 68, No. 4, 1995

VISCOSITY OF DIALLYL ETHER WITHIN THE TEMPERATURE RANGE 291.7-626.6 K AND WITHIN THE PRESSURE RANGE 0.101-58.86 MPa

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UDC 532.13

Results of an experimental investigation of the dynamic viscosity of liquid diallyl ether within the temperature range 291.7–525.6 K and pressure range 0.101–58.86 MPa are presented along with equations describing the relationship between the dynamic viscosity and the density of the substance at various temperatures and pressures.

Measurements of the dynamic viscosity of liquid diallyl ether were carried out using a capillary viscosimeter with the outlying variant [1]. The dynamic viscosity of liquid diallyl ether is studied for the first time within the temperature range 291.7–525.6 K and within the pressure range 0.101–58.86 MPa.

The viscosity of liquid diallyl ether was measured two or three times; in doing so, the reproducibility of result was not worse than 0.05%. The scatter of experimentally measured points from smoothing curves does not exceed 0.07%.

The overall relative mean square error of the dynamic viscosity measurements is 2.6% at the confidence level $\alpha = 0.95$. Results of the experimental investigation of the dynamic viscosity of diallyl ether are presented in Table 1, from which is evident that this quantity decreases with increasing temperature and increases with pressure.

The effect of pressure on the value of the dynamic viscosity of liquid diallyl ether increases with increasing temperature. For example, whereas variation of pressure from 4.9 to 58.86 MPa at temperature 293 K induces a 39.5% increase in η, at the temperature 526.6 K the corresponding increase is just 22.7%.

In order to establish the dynamic viscosity relationships of liquid diallyl ether at high parameters of state, lines T = const were plotted on the $(\Delta\eta, \rho)$ plane, which appeared to be straight lines within the entire range of pressures (Fig. 1).

Based on the law of corresponding states,

$$\frac{\Delta\eta}{\Delta\eta_1} = f\left(\frac{\rho}{\rho_1}\right), \tag{1}$$

where $\Delta\eta$ is the excess viscosity at pressure P and temperature T; $\Delta\eta_1$ is the excess viscosity equal to $\Delta\eta_1 = 70\cdot10^{-6}$ Pa·sec.

An approximation of the dependence (1) for diallyl ether is shown in Fig. 2 from which it is evident that the experimental points fit the commom curve well. We write the equation for this curve:

$$\frac{\Delta\eta}{\Delta\eta_1} = 182.2\left(\frac{\rho}{\rho_1}\right)^2 - 339.8\left(\frac{\rho}{\rho_1}\right) + 158.6\,. \tag{2}$$

Using this equation, one can calculate the dynamic viscosity of liquid diallyl ether as a function of density $\rho_{P,T}$ [2], provided the values of $\Delta\eta_1$ and ρ_1 are known.

Verification of the temperature dependence of ρ_1 has shown that the experimental points fall on a straight line (Fig. 3). The equation for this straight line is as follows:

K. Dzhuraev State Pedagogical University, Dushanbe, Tadjikistan. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 68, No. 4, pp. 619-621, July-August 1995. Original article submitted July 8, 1992; revision submitted April 12, 1994.

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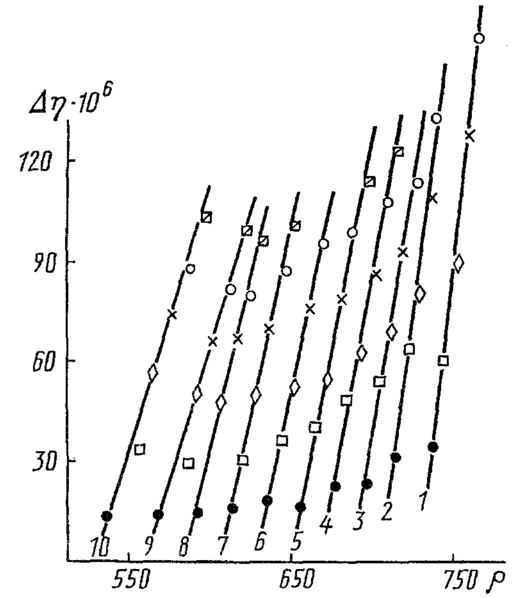

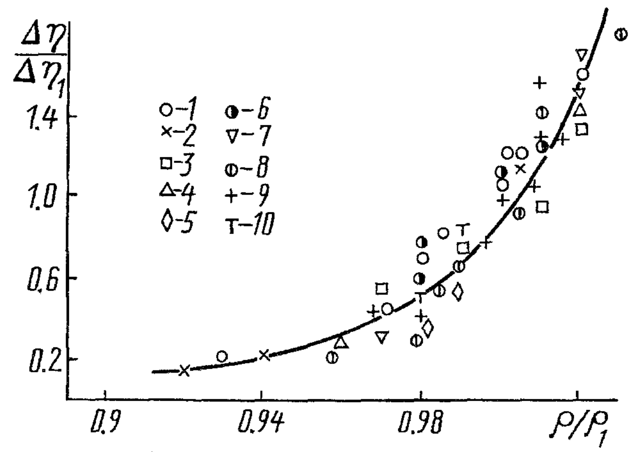

Fig. 1. Dependence of the excess viscosity of diallyl ether on density at T, K: 1) 291.65; 2) 319.62; 3) 341.51; 4) 365.02; 5) 392.24; 6) 416.84; 7) 448.24; 8) 474.16; 9) 491.29; 10) 525.62. $\Delta\eta$, Pa·sec; ρ, kg/m^3.

Fig. 2. Dependence of $\Delta\eta/\Delta\eta_1$ on ρ/ρ_1 for diallyl ether at constant temperatures. Notation the same as in Fig. 1.

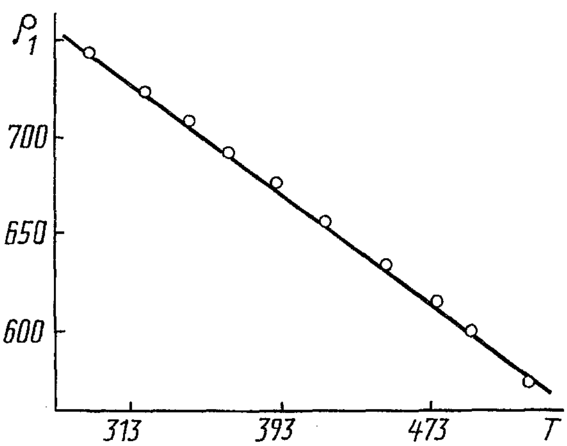

Fig. 3. Temperature dependence of ρ_1 for diallyl ether. ρ, kg/m^3, T, K.

$$\rho_1 = 949.5 - 0.71T. \tag{3}$$

Substituting the values of (3) into (2) we obtain the following expression for the dynamic viscosity of diallyl ether as a function of temperature and pressure:

$$\eta_{P,T} = \eta_T + \frac{1.275\cdot 10^{-2}\rho_{P,T}^2}{(949.5 - 0.71T)^2} - \frac{2.378\cdot 10^{-2}\rho_{P,T}}{949.5 - 0.71T} + 1.1102\cdot 10^{-2}. \tag{4}$$

Using Eq. (4) one can obtain the relationship between the dynamic viscosity and the density of liquid diallyl ether at various temperatures and pressures. At the same time, when experimental data on the density of diallyl ether at various temperatures and pressures [2] are available, one can calculate its dynamic viscosity as a function of temperature and pressure.

Verification of Eq. (4) has shown that the error in the calculated values of dynamic viscosity does not exceed 8% within the temperature range 293–246 K and within the range of pressures 4.91–98.1 MPa. Using this

TABLE 1. Experimental Data on Dynamic Viscosity ($\eta \cdot 10^6$, Pa·sec) of Liquid Diallyl Ether as a Function of Temperature and Pressure

T, K	P, MPa						
	0.98	9.81	19.62	29.43	39.24	49.05	58.86
291.7	340	375	401	431	470	497	523
319.6	251	284	316	334	363	385	402
341.5	210	233	264	280	305	324	343
365.0	170	190	220	233	258	279	295
392.2	138	154	180	193	217	237	252
416.8	111	130	148	165	188	207	220
448.2		100	115	134	154	170	186
475.2		78	93	112	130	143	160
491.3		64	81	100	116	131	150
525.6		39	60	81	98	112	128

equation we calculated the dynamic viscosity of diallyl ether within the temperature range 293–426 K at pressure 98.1 MPa.

REFERENCES

1. I. F. Golubev and N. E. Gnezdilov, Viscosity of Gas Mixtures [in Russian], Moscow (1971).
2. M. M. Safarov, K. D. Guseinov, R. Sh. Asoev, et al., Zh. Fiz. Khim., 66, No. 6, 1697-1701 (1992).