Saturated vapour pressure of acetonitrile

J. DOJČANSKÝ and J. HEINRICH

Department of Chemical Engineering, Slovak Technical University,
880 37 Bratislava

Received 12 September 1973

The saturated vapour pressures of acetonitrile have been measured over the range from 50 to 950 torr. The obtained data have been evaluated statistically by using the Antoine equation. The found constants $A = 7.27748$, $B = 1424.47$, $C = 242.202$ reproduce the values of pressure in torr with a standard deviation of 1.41.

In studying the properties of some acetonitrile solutions it was necessary to know the data on the vapour pressure of this solvent. Since there were great discrepancies in the data available in literature [1, 2, 4] the temperature dependence of vapour pressure was determined experimentally.

Experimental

Acetonitrile obtained by rectifying a chemical grade product of Laborchemie Apolda VEB did not contain any impurities according to the chromatographic analysis performed on an Hewlett—Packard apparatus. The vapour pressure was measured simultaneously by the static method according to *Surový* [6] and in an ebulliometer according to Swiętosławski. The values of pressure were read on the scale of a mercury manometer by means of a cathetometer accurate to ± 0.2 torr; the temperature was measured with a mercury thermometer accurate to ± 0.05 K.

Results

The obtained data were correlated by the Antoine equation

$$\log P = A - \frac{B}{C + t} \tag{1}$$

(where pressure P is given in torr and temperature t in °C) with the statistical weight [8, 9]

$$w = \left[\left(\frac{C + t}{2.303\,P}\right)^2 (0.2)^2 + \left(\frac{B}{C + t}\right)^2 (0.05)^2\right]^{-1}. \tag{2}$$

The system of nonlinear equations ensuing from the least squares method was solved by the Newton method. The following values of the constants in eqn (*1*) were calculated

$$A = 7.27748, \quad B = 1424.472, \quad C = 242.202. \tag{3}$$

The experimental data P^{Ex} (ebulliometric data are denoted by *e*) are confronted with the values P^{C} calculated according to *(1)* and *(2)* in Table 1, the standard deviation being

$$\sqrt{\frac{\sum (P^{Ex} - P^{C})^2}{n - 3}} = 1.41 . \qquad (4)$$

Table 1

Temperature dependence of the vapour pressure of acetonitrile

t [°C]	P^{Ex} [torr]	P^{C} [torr]	$P^{Ex} - P^{C}$
15.1	55.2	55.1	0.1
20.1	70.6	70.3	0.3
25.2	89.4	89.2	0.2
30.7	114.4	114.2	0.2
35.0	137.2	137.6	−0.4
39.95	168.5 e	169.4	−0.9
40.0	169.7	169.7	0.0
44.9	207.3	207.0	0.3
50.1	253.5	253.6	−0.1
54.9	303.9	304.0	−0.1
60.0	367.7	366.3	1.4
64.4	428.9	428.0	0.9
64.95	435.8 e	436.3	−0.5
70.0	517.3	518.6	−1.3
73.05	575.4 e	574.1	1.3
75.1	610.4	614.0	−3.6
77.2	659.7 e	657.2	2.5
81.1	745.8 e	743.8	2.0
85.2	842.8	844.6	−1.8
88.2	924.0	925.0	−1.0
89.2	935.9	953.1	0.8

Discussion

The values of the vapour pressure of acetonitrile obtained by us are near to the data of *Brown* [1]. The data of *Heim* [4] deviate from ours especially at lower temperatures. The data of *Dreisbach* [2] are merely an estimate according to the boiling point based on the Cox diagram. They cannot be compared with the others in the whole investigated pressure range and cannot be recommended.

The cited original data may be found in the form of the constants of the Antoine equation. *Hála et al.* [3] give the constants based on the data of *Brown* [1] while *Wichterle* and *Linek* [8] use the constants given by *Heim* [4]. On the other hand, *Weissberger* [7] takes over the constants of Dreisbach. Heim's data have been processed graphically in tables by *Stull* [5].

References

1. Brown, I., *Aust. J. Chem.* ***7***, 269 (1954).
2. Dreisbach, R. R. and Martin, R. A., *Ind. Eng. Chem.* ***41***, 2875 (1949).
3. Hála, E., Wichterle, I., Polák, J., and Boublík, T., *Vapour—Liquid Equilibrium Data*, p. 23. Pergamon Press, Oxford, 1968.
4. Heim, D., *Bull. Soc. Chim. Belges* ***42***, 467 (1933).
5. Stull, D. R., *Ind. Eng. Chem.* ***39***, 517 (1947).
6. Surový, J., *Habilitation Thesis*, p. 18. Slovak Technical University, Bratislava, 1969.
7. Weissberger, A. and Proskauer, E. S., *Organic Solvents*, p. 224. Wiley, New York, 1955.
8. Wichterle, I. and Linek, J., *Antoine Vapor Pressure Constants of Pure Compounds*, p. 14. Academia, Prague, 1971.
9. Willingham, C. B., Taylor, W. J., Fignocco, J. M., and Rossini, F. D., *J. Res. Nat. Bur. Stand.* ***35***, 219 (1954).

Translated by R. Domanský