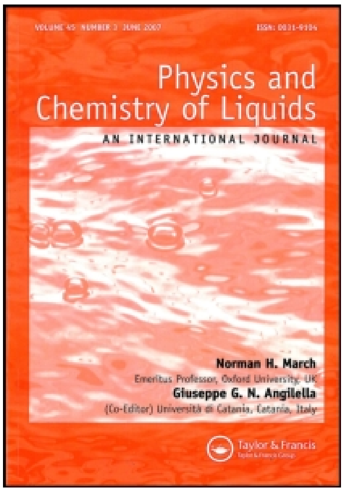

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Integral Isobaric Heats of Vaporization of Methanol 1,2-Dichloroethane, 1,1,1-Trichloroethane Mixtures

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INTEGRAL ISOBARIC HEATS OF VAPORIZATION OF METHANOL + 1,2-DICHLOROETHANE, + 1,1,1-TRICHLOROETHANE MIXTURES

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A modified form of Dana's apparatus is employed to measure the integral isobaric heats of vaporization of methanol-1,2-dichloroethane and methanol-1,1,1-trichloroethane mixtures at 720 mm Hg. The results are in good agreement with the values calculated from Gambill's equation.

KEY WORDS: Heat of vaporization, mixtures, methanol, 1,2-dichloroethane, 1,1,1-trichloroethane.

INTRODUCTION

Integral isobaric heats of vaporization are among the most important inputs in the design and operation chemical processes. The present study is a part of experimental programme of the investigators aiming at the measurement of important thermophysical properties of pure substances and mixtures. A brief description of a simple apparatus and measurements on the integral isobaric heats of vaporization of the binary mixtures of: methanol-1,2-dichloroethane, and methanol-1,1,1-trichloroethane are presented.

APPARATUS AND EXPERIMENTAL

A modified form of Dana's[1] apparatus, essentially similar to that described earlier[2], has been designed, fabricated in glass and used for the present study. The apparatus, shown schematically in Figure 1, consists of a 3 litre capacity preheater (7) heated by an external heater (8). The liquid from the preheater flows to the calorimeter (6), and

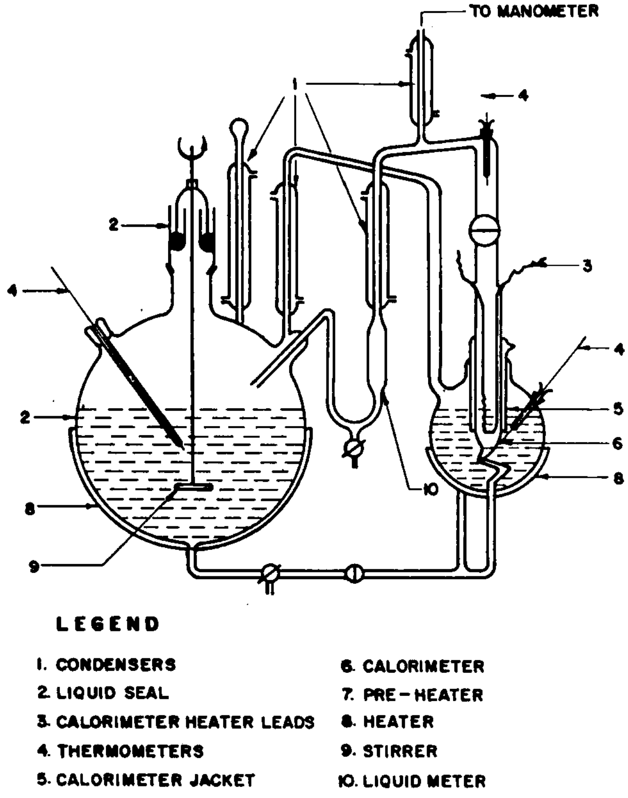

Figure 1 Schematic diagram of the enthalpy of vaporization apparatus

the surrounding flask through a glass tube. The calorimeter is provided with a heater (3) made out of nichrome wire fused to two copper lead wires, and is surrounded by a jacket (5) and an annular space evacuated to 10^{-4} mm Hg. The vapors from the calorimeter are condensed and siphoned to the preheater through the liquid meter (10), whose volume between the fixed marks, has been carefully calibrated. The condensers (1), liquid seal (2), the heaters (8) and stirrer (9) help in the development and maintenance of equilibrium conditions in the apparatus. A carefully calibrated mercury-in-glass thermometer (4) is used to measure the temperature to an accuracy of $\pm 0.05°C$. The power to the calorimeter heater is supplied from a D.C. source and the voltage and current are measured to an accuracy of ± 0.025 V and ± 0.05 amps by means of calibrated meters.

About 2 litres of the liquid (pure substance or mixture) to be studied is charged to the preheater and heated to about 1°C below the bubble point temperature. Simultaneously, the liquid mixture in the flask is also heated to the same temperature. The heater in the calorimeter is also switched on and a steady constant voltage maintained across the heater. The vapor line is heated by means of another carefully controlled heater to prevent any condensation of the vapor. The attainment of equilibrium conditions at the end of about two hours is judged by constancy and identity of the composition of the sample collected from the liquid meter with that initially charged. Time required for the collection of the liquid between the two fixed marks of the liquid meter (t_h) the voltage (V) Current (I), the weight of the liquid mixture occupying the space between the two fixed marks are all measured and noted. The measurements are carried out at the prevailing local atmospheric pressure of 720 ± 1 mm Hg.

RESULTS AND DISCUSSION

The refractive-index and density of the samples of pure substances used in this study are compared with the literature data[3] in Table 1. Mixture samples are prepared by mixing weighed quantities of the pure liquids and their compositions are checked by refractive-index measurements at 30°C. The results on the pure liquid heats of vaporization compared with the literature values[4] in Table 2, indicate that the method and the apparatus are capable of measuring the property with a maximum deviation of about 0.1 %.

The mixture data are summarized in Tables 3 and 4. Gambill's equation[5]

$$L = \Sigma L_i x_i \pm \Delta H_m + \int_{T_1}^{T_2} x_i C_{Pi} \, dT$$

with the assumption that heat of mixing (ΔH_m) is negligible, in conjunction with the ideal gas heat capacity (C_p) data available in the literature[6,7], has been used to

Table 1 Comparison of the physical properties of the pure liquids with literature data at 30°C.

Substance	*Density, g/ml*		*Refractive-idex*	
	This work	*Literature*[3]	*This work*	*Literature*[4]
Methanol	0.7820	0.7819	1.3244	1.3245
1,2-Dichloroethane	1.2400	1.2390	1.4392	1.4393
1,1,1-Trichloroethane	1.3207	1.3209	1.4321	1.4320

Table 2 Comparison of heats of Vaporization of the pure liquids with literature data.

Substance	*Heat of Vaporization, Cal/g. mol*	
	This work	*Literature*[4]
Methanol	8664.24	8659.60
1,2-Dichloroethane	6919.57	6912.65
1,1,1-Trichloroethane	7326.23	7330.90

Table 3 Latent heat of vaporization of methanol-1,2-dichloroethane mixtures.

Mole fraction of methanol	*Enthalpy of Vaporization, Cal/g. mole*	
	Experimental	*Calculated*
0.09	7555.01	7551.20
0.18	7701.41	7698.35
0.29	7820.68	7815.62
0.40	7937.58	7919.79
0.50	8031.66	8016.26
0.59	8138.29	8121.37
0.70	8303.49	8284.24
0.80	8450.25	8439.28
0.88	8573.13	8563.76
0.95	8652.85	8651.31

Table 4 Latent heat of Vaporization of methanol-1,1,1-trichloroethane mixtures.

Mole fraction of methanol	*Enthalpies of Vaporization, Cal/g. mole*	
	Experimental	*Calculated*
0.105	7876.57	7870.39
0.190	7960.00	7922.54
0.310	8056.72	8040.67
0.400	8140.60	8126.03
0.505	8231.38	8214.33
0.610	8356.81	8339.79
0.710	8498.94	8484.03
0.870	8606.85	8581.23
0.940	8649.61	8643.96

calculate mixture heats of vaporization. It can be seen from Tables 3 and 4 that the calculated and experimental values agree with a maximum deviation of 0.47 % and an average absolute deviation of 0.15 %.

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