Table VI. Coefficients c_i of Equation 6 for 1,2-Ethanediol (1) + 1,2-Dimethoxyethane (2)

t/°C	c_0	c_1	c_2	c_3	c_4	$\sigma \times 10$
−10	−36.73	11.47	44.27	5.49	−102.93	7.2
0	−34.64	11.18	39.80	5.12	−93.96	7.4
10	−33.22	11.82	36.87	4.69	−87.21	7.7
20	−31.11	11.37	31.78	3.57	−75.53	7.2
30	−29.20	10.91	27.36	3.58	−66.00	6.9

It has been postulated that small negative deviations on this excess nonthermodynamic property ($\epsilon^E \leq 5$) are a consequence either of weak dipole–dipole association phenomena or of hydrogen-bonded complexes (*9*). In this case, the presence of the minimum appears strictly related to the complex formation either by strong hydrogen bonds or by dipolar interactions ($\epsilon^E < -5$ at 30 °C).

Furthermore, the position of the minimum in Figure 1 indicates the formation of a stable complex adduct, consisting of one molecule of 1,2-ethanediol and one molecule of 1,2-dimethoxyethane at all the temperatures.

Registry No. 1, 107-21-1; 2, 110-71-4.

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Received for review December 9, 1991. Accepted January 30, 1992. The Consiglio Nazionale delle Ricerche (CNR) of Italy is gratefully acknowledged for financial support.

High-Pressure Vapor–Liquid Equilibrium Data for Binary Mixtures Containing N_2, CO_2, H_2S, and an Aromatic Hydrocarbon or Propylcyclohexane in the Range 313–473 K

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Experimental binary vapor–liquid equilibrium data were obtained for mixtures of one light component, among nitrogen, carbon dioxide, and hydrogen sulfide, and one heavy component, among toluene, *m*-xylene, mesitylene, *n*-propylcyclohexane, and *n*-propylbenzene. Three static analytical methods differing by the sampling technique and one static synthetic method were used at about 313, 393, and 473 K.

Introduction

The data were tested according to the consistency test of Prausnitz–Keeler (*2*) in the range of low pressures and temperatures where it can be applied. Although some data had to be checked against other experimental methods (*3*) and rejected, all the other points given here were found consistent.

The experimental data reported here are part of a large data base collected by Gas Processors Association (GPA) and used to determine interaction parameters for equation of state models. Other relevant measurements from Ecole des Mines were presented in a previous paper (*1*).

Experimental Section

Apparatus. Equipment and procedure for each experimental method are described in previous publications: Legret et al. (*4*) for apparatus 1, Figuière et al. (*5*) for apparatus 2, Fontalba et al. (*6*) for apparatus 3, and Laugier and Richon (*7*) for apparatus 4.

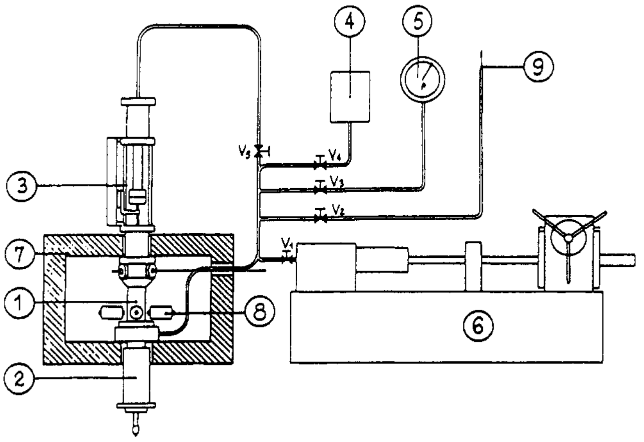

Figure 1. Static apparatus with variable volume cell, flow diagram: (1) equilibrium cell; (2) assembly for piston-level measurements; (3) assembly for interface level measurements; (4) pressurizing liquid reservoir; (5) manometer; (6) high-pressure pump; (7) air thermostat; (8) solenoids; (9) fitting to vacuum pump; (V_1–V_5) shut-off valves.

Figures 1 and 2 refer to apparatus 3 based on a static synthetic method. The variable-volume cell (Figure 2) allows pressure P determinations as a function of the volume V up to 45 MPa and 423 K. Below the mixture critical pressure, the P–V curves display a break point at the bubble pressure and a volume corresponding to the saturated liquid molar volume. The composition of the saturated liquid at the break point is known by weighing the components into the systems during the loading procedure.

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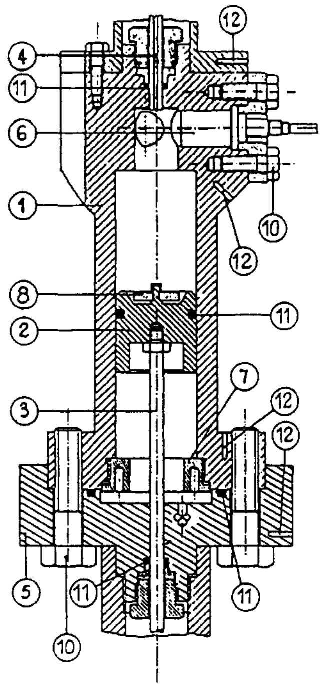

Figure 2. Static apparatus with variable volume cell, equilibrium cell: (1) cell body; (2) piston; (3) probe for piston-level measurements; (4) thermistor probe for vapor–liquid interface level measurements; (5) pressurizing assembly; (6) membrane pressure transducer; (7) stop screw; (8) magnetic rod; (9) seat of the feeding valve; (10) bolts; (11) viton O ring; (12) thermocouple well.

Table I. Refractive Indexes n_D and Densities ρ of the Materials Used

material	n_D(293.15 K)		ρ(293.15 K)/(g cm^{-3})	
	this work	lit. (*11*)	this work	lit. (*11*)
toluene	1.496 91	1.496 78	0.866 98	0.8669
m-xylene	1.497 58	1.497 22	0.864 34	0.8642
mesitylene	1.498 5	1.499 37	0.865 0	0.8651
n-propylbenzene	1.492 3	1.492 02	0.862 1	0.8620
n-propylcyclohexane	1.436 9	1.437 05	0.793 6	0.7936

Pressures were measured through pressure transducers calibrated at each working temperature against a dead-weight gauge, either from Budenberg, Model 280 H, for pressures up to 100 MPa, associated to a null differential pressure transducer and indicator (Ruska Model 2413-705 and Model 2416-708) or Desgranges and Huot, Model 5202, for pressures up to 40 MPa.

Temperatures T were measured through iron–constantan thermocouples periodically calibrated against a 25-Ω platinum probe (Lyon-Alemand-Louyot, Model STHP B) fitted with a four-way multimeter (Enertec, Schlumberger 7081; 2 × 10^7 points).

Weights were obtained within 10^{-3} g through an analytical balance from Mettler.

The thermal conductivity detectors used to obtain phase composition after sampling in apparatus 1, 2, and 4 were repeatedly calibrated by introducing pure components through a syringe. When hydrogen sulfide was used, a special thermal conductivity detector was fitted with a platinum wire.

Sources and Purities of Chemicals. Chemicals were used without any further purification except for a careful degassing of the liquids. Nitrogen, carbon dioxide, and hydrogen sulfide were from L'Air Liquide with GLC purities of 99.9, 99.995, and 99.999 mol %, respectively. Toluene, *m*-xylene, and *n*-propylbenzene were provided by Merck with reported GLC purities of 99.5, 98.5, and 99 mol %, respectively. Mesitylene from Fluka and *n*-propylcyclohexane from Sigma had a minimum GLC purity of 99.0 mol %. Refractive indexes n_D of the liquid components were measured within 0.000 05 with a prism refractometer fitted with a sodium vapor lamp (Carl Zeiss). Densities ρ were measured within 0.000 03 g cm^{-3} with a vibrating-tube densimeter (Anton Paar, Model DMA 46) (Table I).

Experimental Results

Results are reported in Tables II–VII. Uncertainties in all variables are given in the tables. Composition uncertainties result from an error calculation taking into account the uncertainty in detector calibration, $\sigma(R_i)$, and repeatability of chromatographic areas, $\sigma(A_i)$, on at least five samples corresponding to the same equilibrium.

Table II. Vapor–Liquid Equilibrium Data for the System Nitrogen (1)–Toluene (2): Temperature T, Pressure P, Liquid Mole Fraction x_1, and Vapor Mole Fraction y_1[a]

P/(MPa)	x_1	y_1	P/(MPa)	x_1	y_1
		T/K = 313.2 (1)			
10.2 (1)	0.056 (3)[b]	0.9972 (2)[b]	60.2 (1)	0.205 (3)[b]	0.9910 (5)[b]
20.0 (1)	0.097 (2)[b]	0.9965 (3)[b]	70.1 (1)	0.228 (3)[b]	0.9900 (5)[b]
30.3 (1)	0.128 (2)[b]	0.9955 (3)[b]	80.0 (1)	0.247 (3)[b]	0.989 (1)[b]
40.0 (1)	0.153 (2)[b]	0.9940 (3)[b]	89.9 (1)	0.267 (2)[b]	0.987 (1)[b]
50.2 (1)	0.183 (2)[b]	0.9930 (5)[b]	100.0 (1)	0.284 (3)[b]	0.9830 (5)[b]
		T/K = 391.5 (5)			
2.90 (4)	0.018 (1)[c]		21.25 (4)	0.130 (6)[c]	
4.90 (4)	0.031 (2)[c]		25.80 (4)		0.980 (7)[c]
9.00 (4)	0.060 (3)[c]		26.30 (4)	0.160 (5)[c]	
9.75 (4)		0.980 (2)[c]	29.70 (4)	0.180 (6)[c]	0.970 (3)[c]
14.60 (4)		0.980 (3)[c]	30.35 (4)	0.180 (5)[c]	
14.75 (4)	0.090 (3)[c]		32.90 (4)	0.20 (1)[c]	0.960 (3)[c]
20.90 (4)		0.980 (3)[c]	38.50 (4)	0.24 (1)[c]	0.960 (4)[c]
		T/K = 472.6 (5)			
2.20 (4)		0.61 (1)[c]	30.20 (4)		0.870 (9)[c]
3.55 (4)	0.027 (3)[c]	0.730 (9)[c]	30.75 (4)	0.279 (8)[c]	
3.70 (4)	0.035 (2)[c]		32.90 (4)	0.31 (1)[c]	
4.90 (4)	0.045 (3)[c]	0.79 (1)c	35.20 (4)	0.33 (1)[c]	
9.00 (4)	0.082 (5)[c]	0.863 (5)[c]	34.80 (4)		0.87 (1)[c]
15.75 (4)	0.145 (10)[c]	0.887 (8)[c]	35.90 (4)	0.350 (9)[c]	
18.40 (4)	0.180 (9)[c]		38.60 (4)		0.855 (8)[c]
22.05 (4)	0.210 (8)[c]	0.881 (8)[c]	39.60 (4)	0.390 (7)[c]	0.860 (8)[c]
24.75 (4)	0.225 (7)[c]		40.00 (4)	0.390 (1)[c]	
26.50 (4)	0.244 (7)[c]	0.875 (8)[c]			

[a] The digits in parentheses represent uncertainties σ in terms of the final listed digits of the values. [b] Apparatus 1 (*8*). [c] Apparatus 2 (*8*).

Table III. Vapor–Liquid Equilibrium Data for the System Nitrogen (1)–*m*-Xylene (2): Temperature T, Pressure P, Liquid Mole Fraction x_1, and Vapor Mole Fraction y_1[a]

P/(MPa)	x_1	y_1	P/(MPa)	x_1	y_1
T/K = 313.2 (1)					
10.2 (1)	0.061 (2)[b]	0.9990 (2)[b]	60.2 (1)	0.214 (4)[b]	0.9939 (3)[b]
20.1 (1)	0.107 (2)[b]	0.9989 (2)[b]	69.9 (1)	0.235 (3)[b]	0.9928 (3)[b]
30.0 (1)	0.137 (2)[b]	0.9982 (2)[b]	80.2 (1)	0.250 (2)[b]	0.9911 (5)[b]
39.9 (1)	0.165 (3)[b]	0.9973 (2)[b]	89.9 (1)	0.262 (2)[b]	0.9885 (5)[b]
50.1 (1)	0.196 (3)[b]	0.9958 (3)[b]	100.1 (1)	0.280 (2)[b]	0.9865 (5)[b]
T/K = 391.5 (1)					
5.20 (1)	0.042 (5)[b]		29.85 (1)	0.173 (3)[b]	
10.15 (1)	0.070 (5)[b]		35.20 (1)	0.202 (5)[b]	
15.20 (1)	0.096 (3)[b]		40.50 (1)	0.225 (5)[b]	
21.10 (1)	0.130 (3)[b]		44.80 (1)	0.262 (7)[b]	
21.90 (1)	0.135 (3)[b]		49.90 (1)	0.279 (5)[b]	
25.20 (1)	0.153 (3)[b]	0.988 (2)[b]	50.05 (1)	0.280 (5)[b]	0.984 (2)[b]
T/K = 391.5 (5)					
1.15 (4)		0.953 (5)[c]	5.20 (4)		0.983 (5)[c]
2.10 (4)		0.969 (5)[c]	10.30 (4)		0.984 (5)[c]
3.10 (4)		0.975 (5)[c]	15.20 (4)		0.984 (5)[c]
4.15 (4)		0.980 (5)[c]			
T/K = 472.6 (5)					
2.30 (4)	0.019 (1)[c]	0.770 (15)[c]	28.10 (4)		0.92 (1)[c]
3.10 (4)	0.029 (2)[c]	0.810 (12)[c]	30.15 (4)	0.266 (9)[c]	
5.10 (4)	0.044 (2)[c]	0.88 (1)[c]	35.10 (4)	0.31 (1)[c]	
10.20 (4)	0.090 (2)[c]	0.92 (1)[c]	35.90 (4)		0.93 (1)[c]
15.10 (4)	0.135 (5)[c]		40.00 (4)	0.35 (1)[c]	
21.35 (4)	0.187 (6)[c]		39.20 (4)		0.93 (1)[c]
25.10 (4)	0.218 (7)[c]				

[a] The digits in parentheses represent uncertainties σ in terms of the final listed digits of the values. [b] Apparatus 1 (*8*). [c] Apparatus 2 (*8*).

Table IV. Vapor–Liquid Equilibrium Data for the System Nitrogen (1)–Mesitylene (2): Temperature T, Pressure P, Liquid Mole Fraction x_1, and Vapor Mole Fraction y_1[a]

P/(MPa)	x_1	y_1	P/(MPa)	x_1	y_1
T/K = 313.2 (1)					
10.1 (1)	0.059 (2)[b]	>0.9992 (7)[b]	60.4 (1)	0.211 (2)[b]	0.9965 (3)[b]
20.1 (1)	0.093 (2)[b]	>0.9992 (7)[b]	70.0 (1)	0.235 (3)[b]	0.9960 (3)[b]
30.4 (1)	0.131 (2)[b]	0.9987 (2)[b]	80.0 (1)	0.260 (3)[b]	0.9950 (5)[b]
39.9 (1)	0.162 (2)[b]	0.9985 (2)[b]	90.1 (1)	0.283 (1)[b]	0.9945 (5)[b]
50.2 (1)	0.191 (2)[b]	0.9973 (4)[b]	99.8 (1)	0.302 (1)[b]	0.9940 (5)[b]
T/K = 393.2 (1)					
10.1 (1)	0.071 (5)[b]		30.4 (1)	0.179 (3)[b]	0.984 (2)[b]
10.5 (1)		>0.984 (7)[b]	35.2 (1)	0.209 (3)[b]	0.985 (2)[b]
15.2 (1)	0.099 (3)[b]		40.2 (1)	0.235 (5)[b]	0.985 (2)[b]
15.3 (1)		0.984 (2)[b]	45.2 (1)	0.272 (5)[b]	0.986 (2)[b]
19.0 (1)	0.119 (2)[b]		50.1 (1)	0.300 (4)[b]	0.986 (1)[b]
20.2 (1)		0.984 (2)[b]	53.1 (1)	0.333 (3)[b]	0.983 (1)[b]
25.2 (1)	0.150 (2)[b]	0.985 (2)[b]			
T/K = 472.6 (5)					
1.10 (4)		0.78 (2)[c]	20.10 (4)	0.182 (5)[c]	
2.10 (4)	0.018 (1)[c]	0.876 (7)[c]	20.35 (4)		0.97 (1)[c]
3.70 (4)	0.036 (3)[c]		25.10 (4)	0.224 (5)[c]	
4.10 (4)		0.92 (1)[c]	30.10 (4)	0.264 (6)[c]	
6.05 (4)		0.93 (1)[c]	30.25 (4)		0.96 (1)[c]
8.10 (4)	0.074 (6)[c]		35.15 (4)	0.300 (10)[c]	
8.15 (4)		0.95 (1)[c]	38.90 (4)		0.965 (8)[c]
11.10 (4)	0.103 (5)[c]		40.00 (4)		0.96 (1)[c]
15.10 (4)	0.139 (5)[c]		40.25 (4)	0.340 (8)[c]	
15.20 (4)		0.969 (8)[c]			

[a] The digits in parentheses represent uncertainties σ in terms of the final listed digits of the values. [b] Apparatus 1 (*8*). [c] Apparatus 2 (*8*).

The number of moles, N_i, of each component is computed from the chromatographic peak areas, A_i:

$$N_i = A_i R_i \tag{1}$$

where R_i is the response coefficient of the detector for component i. Thus for a binary system, the error on mole fraction $\sigma(z_1)$, where $z = x$ (liquid) or $z = y$ (vapor), is

$$\frac{\sigma(z_1)}{z_1} = z_2\left[\frac{\sigma(A_1)}{A_1} + \frac{\sigma(R_1)}{R_1} + \frac{\sigma(A_2)}{A_2} + \frac{\sigma(R_2)}{R_2}\right] \tag{2}$$

Recently Kim et al. (*12*) have reported data for the carbon dioxide–*n*-propylcyclohexane system. Their data are plotted along with ours in Figure 3. They all display a very good agreement. The small deviation at the lowest temperature is due to the fact that two sets of data are not exactly at the same temperature. Figure 4 is a confirmation of the good agreement between data. Kim et al. partition coefficients appear inside our experimental uncertainty range. Figures 3 and 4 also illustrate the advantage of static methods to reach the vicinity of the critical region.

Table V. Vapor–Liquid Equilibrium Data for the System Nitrogen (1)–Propylcyclohexane (2): Temperature T, Pressure P, Liquid Mole Fraction x_1, and Vapor Mole Fraction y_1^{a}

P/(MPa)	x_1	y_1	P/(MPa)	x_1	y_1
T/K = 313.6 (1)					
9.8 (1)	0.088 (1)^b	0.9991 (5)^b	69.0 (1)		0.9940 (8)^b
20.0 (1)	0.153 (3)^b	0.9987 (5)^b	69.4 (1)	0.330 (5)^b	
29.6 (1)	0.198 (3)^b	0.9984 (5)^b	79.8 (1)		0.9925 (9)^b
39.7 (1)	0.244 (3)^b	0.9976 (6)^b	80.0 (1)	0.360 (5)^b	
49.9 (1)	0.277 (3)^b	0.9961 (9)^b	88.7 (1)		0.9918 (6)^b
60.2 (1)		0.9960 (8)^b	89.0 (1)	0.383 (5)^b	
60.4 (1)	0.310 (4)^b		99.7 (1)	0.408 (5)^b	0.9904 (6)^b
T/K = 393.2 (5)					
2.02 (4)	0.0230 (4)^c	0.972 (5)^c	20.00 (4)	0.198 (5)^c	0.987 (3)^c
2.95 (4)	0.034 (1)^c		25.00 (4)	0.238 (6)^c	0.987 (3)^c
5.10 (4)	0.054 (2)^c	0.982 (5)^c	30.00 (4)	0.276 (6)^c	0.983 (5)^c
10.10 (4)	0.106 (3)^c	0.989 (5)^c	34.95 (4)	0.313 (8)^c	0.982 (3)^c
15.00 (4)	0.155 (4)^c	0.987 (3)^c	39.95 (4)	0.338 (6)^c	0.980 (3)^c
T/K = 472.9 (5)					
1.64 (4)	0.0204 (5)^c		19.90 (4)	0.248 (3)^c	0.947 (4)^c
2.10 (4)	0.0271 (5)^c	0.844 (5)^c	25.00 (4)	0.301 (3)^c	0.951 (2)^c
3.10 (4)	0.0411 (5)^c	0.886 (4)^c	30.00 (4)	0.356 (3)^c	0.948 (2)^c
5.10 (4)	0.068 (1)^c	0.922 (3)^c	35.00 (4)	0.406 (5)^c	0.942 (2)^c
10.00 (4)	0.131 (1)^c	0.944 (3)^c	40.05 (4)	0.459 (4)^c	0.940 (2)^c
15.00 (4)	0.191 (2)^c	0.949 (3)^c			

[a] The digits in parentheses represent uncertainties σ in terms of the final listed digits of the values. [b] Apparatus 1 (*9*). [c] Apparatus 2 (*9*).

Table VI. Vapor–Liquid Equilibrium Data for the System Carbon Dioxide (1)–*n*-Propylcyclohexane (2): Temperature T, Pressure P, Liquid Mole Fraction x_1, and Vapor Mole Fraction y_1^{a}

P/(MPa)	x_1	y_1	P/(MPa)	x_1	y_1
T/K = 313.1 (1)					
1.03 (3)	0.089 (2)^d		5.14 (3)	0.4405 (7)^d	
1.08 (2)		0.9984 (2)^b	5.63 (2)		0.99853 (5)^b
1.58 (2)		0.9988 (1)^b	5.97 (3)	0.5262 (7)^d	
2.11 (2)		0.9989 (1)^b	6.64 (3)	0.6057 (6)^d	
2.54 (3)	0.209 (2)^d		6.93 (2)		0.9976 (1)^b
3.05 (2)		0.99900 (5)^b	7.28 (3)	0.7179 (4)^d	
4.02 (3)	0.343 (5)^d	0.99890 (5)^b	7.84 (2)		0.9960 (2)^b
T/K = 393.2 (5)					
2.05 (4)	0.097 (1)^c	0.967 (9)^c	12.31 (4)	0.523 (7)^c	0.973 (4)^c
4.28 (4)	0.194 (2)^c	0.981 (4)^c	15.25 (4)	0.643 (6)^c	0.957 (3)^c
6.37 (4)	0.287 (4)^c	0.982 (2)^c	17.20 (4)	0.732 (4)^c	0.940 (3)^c
9.00 (4)	0.393 (6)^c	0.984 (2)^c	18.20 (4)	0.792 (5)^c	0.913 (3)^c
T/K = 472.8 (5)					
2.05 (4)	0.067 (2)^c	0.837 (9)^c	12.15 (4)	0.411 (8)^c	0.925 (3)^c
4.15 (4)	0.140 (4)^c	0.888 (5)^c	12.90 (4)		0.916 (4)^c
6.25 (4)	0.213 (6)^c	0.906 (4)^c	15.40 (4)		0.905 (3)^c
8.05 (4)	0.276 (7)^c	0.913 (4)^c	15.95 (4)	0.547 (7)^c	
10.10 (4)		0.921 (4)^c	17.55 (4)	0.610 (8)^c	0.879 (3)^c
10.25 (4)	0.350 (9)^c	0.923 (4)^c	18.35 (4)	0.644 (7)^c	

[a] The digits in parentheses represent uncertainties σ in terms of the final listed digits of the values. [b] Apparatus 1 (*9*). [c] Apparatus 2 (*9*). [d] Apparatus 3 (*9*).

Table VII. Vapor–Liquid Equilibrium Data for the System Hydrogen Sulfide (1)–*n*-Propylbenzene (2): Temperature T, Pressure P, Liquid Mole Fraction x_1, and Vapor Mole Fraction y_1^{a}

P/(MPa)	x_1	y_1	P/(MPa)	x_1	y_1
T/K = 313.2 (2)					
0.395 (5)	0.110 (4)^b	0.9973 (5)^b	1.730 (5)	0.648 (8)^b	0.99967 (6)^b
0.715 (5)	0.245 (8)^b	0.9988 (4)^b	2.090 (5)	0.766 (9)^b	0.99975 (6)^b
1.050 (5)	0.362 (9)^b	0.9991 (4)^b	2.420 (5)	0.874 (8)^b	0.99987 (4)^b
1.420 (5)	0.515 (10)^b	0.9995 (1)^b	2.570 (5)	0.921 (4)^b	0.99988 (4)^b
T/K = 393.4 (2)					
1.04 (1)	0.136 (3)^b	0.963 (2)^b	6.07 (1)	0.648 (8)^b	0.987 (1)^b
1.73 (1)	0.219 (6)^b	0.974 (2)^b	6.90 (1)	0.717 (7)^b	0.986 (2)^b
2.35 (1)	0.302 (7)^b	0.979 (2)^b	8.06 (1)	0.801 (5)^b	0.985 (2)^b
3.68 (1)	0.441 (8)^b	0.985 (2)^b	9.29 (1)	0.888 (4)^b	0.982 (2)^b
4.92 (1)	0.553 (9)^b	0.986 (1)^b			
T/K = 473.5 (2)					
1.51 (1)	0.093 (4)^b	0.787 (12)^b	7.47 (1)	0.447 (9)^b	0.922 (4)^b
2.98 (1)	0.199 (7)^b	0.859 (12)^b	8.96 (1)	0.525 (8)^b	0.923 (5)^b
4.65 (1)	0.293 (7)^b	0.902 (8)^b	11.44 (1)	0.651 (7)^b	0.917 (4)^b
6.01 (1)	0.364 (9)^b	0.917 (3)^b	12.97 (1)	0.726 (7)^b	0.900 (4)^b

[a] The digits in parentheses represent uncertainties σ in terms of the final listed digits of the values. [b] Apparatus 4 (*10*).

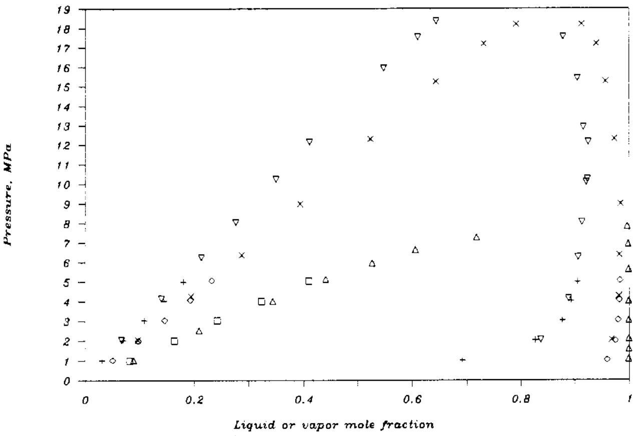

Figure 3. Pressure versus composition diagram for the carbon dioxide (1)–*n*-propylcyclohexane (2) system: (△) this work at 313.1 K; (×) this work at 393.2 K; (▽) this work at 472.8 K; (□) from Kim et al. (*12*) at 315.4 K; (◇) from Kim et al. (*12*) at 392.7 K; (+) from Kim et al. (*12*) at 474.6 K.

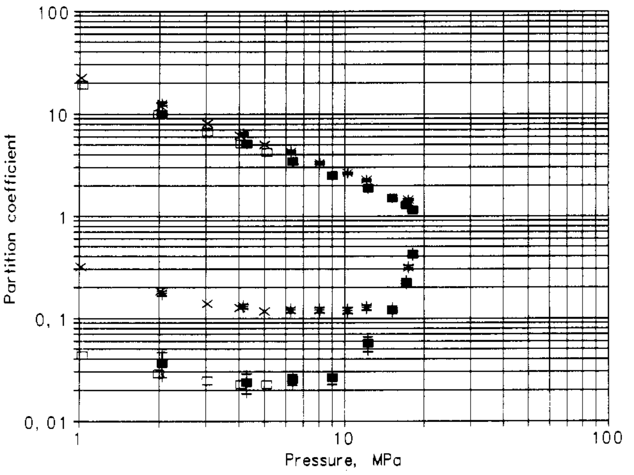

Figure 4. Partition coefficient versus pressure diagram for the carbon dioxide (1)–*n*-propylcyclohexane (2) system: (■) this work at 393.2 K (indicated with error bars); (✳) this work at 472.8 K (indicated with error bars); (□) from Kim et al. (*12*) at 392.7 K; (×) from Kim et al. (*12*) at 474.6 K.

Acknowledgment

We are grateful to the members of the *K* value Screening Committee, especially to Dr. H. Kistenmacher, for encouragement and advice, and we thank A. Chareton, A. Valtz, P. Alali, C. Lafeuil, F. Fontalba, J. Destève, and D. Legret for their contribution.

Registry No. N_2, 7727-37-9; CO_2, 124-38-9; H_2S, 7783-06-4; propylcyclohexane, 1678-92-8; toluene, 108-88-3; *m*-xylene, 108-38-3; mesitylene, 108-67-8; propylbenzene, 103-65-1.

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Received for review January 22, 1991. Revised October 21, 1991. Accepted October 21, 1991. We are grateful to the Gas Processors Association for financial support.

Phase Compositions, Viscosities, and Densities for Aqueous Two-Phase Systems Composed of Polyethylene Glycol and Various Salts at 25 °C

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Phase diagrams of aqueous two-phase systems composed of polyethylene glycol and various salt solutions were measured. The densities and viscosities of these phase systems were also measured. Polyethylene glycol was used with three average molecular masses of 1000, 3350, and 8000. The salts used were magnesium sulfate, sodium sulfate, sodium carbonate, ammonium sulfate, and potassium phosphate. Phase diagram data, as well as the densities and viscosities of the phases, were measured at 25 °C.

Introduction

Liquid–liquid extraction utilizing aqueous two-phase systems (ATPS) has been used to separate and purify biological products from the complex mixtures in which they are produced (*1*, *2*). Data on the composition and properties of phase systems are necessary for the design of ATPS extraction processes. Phase-diagram data are also necessary for the development of models that predict phase partitioning (*3*–*6*).

In this work, a comprehensive set of densities, viscosities, and phase compositions of ATPS composed of various polyethylene glycol (PEG) masses and salts were measured at 25 °C. A previous technique has been used to determine compositions of polymer–polymer systems utilizing measurements of optical rotation and refractive index (*1*, *2*, *7*, *8*). However the PEG–salt systems have little or no optical activity. Potassium phosphate–PEG systems can be determined by titration (*1*); however, this method does not apply to the other salts used. Therefore, the gravimetric method of determining phase composition described by Stewart and Todd (*9*) was used and