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ESTIMATION OF PRESSURE DEPENDENT THERMODYNAMIC PROPERTIES OF BINARY LIQUID MIXTURES USING FLORY'S STATISTICAL THEORY DEVELOPED FOR HIGH PRESSURE

J.D. PANDEY[a] AND V.K. SINGH[b1]

[a]Department of Chemistry, University of Allahabad, Uttar Pradesh, India
[b]Department of Physics, VSSD College, Kanpur, Uttar Pradesh, India

ABSTRACT

Heat capacity at constant pressure (C_P), excess heat capacity (C_P^E), heat capacity at constant volume (C_V) and heat capacities ratio (γ) of toluene+ o-xylene and toluene+ aniline have been estimated using Flory's statistical theory at elevated pressures, the required experimental data have been taken from literature. A satisfactory agreement between estimated and experimental values has been obtained showing the validity of Flory theory at elevated pressures.

KEYWORDS: Flory's Statistical Theory, Elevated Pressures, Binary Liquid Mixtures, Heat Capacities

Heat capacity measurements (Ball *et al.*, 1988, 1989) have been found to be useful in the investigation of change of liquid structure taking place during mixing. Heat capacity is a second- order thermodynamic quantity and it seems to be unique amongst thermodynamic quantities as an indicator to changes of structure (i.e., order) or non-randomness in pure liquids and mixtures (Costas and Patterson, 1987) during the mixing process. Thus, order- destruction and order- creation processes in mixtures can also be studied through determination of the corresponding excess quantity. Heat capacity measurements were carried out by (Van and Patterson, 1982; Dominguez *et al.*, 1993) and (Ahluwalia *et al.*, 1998; Ahluwalia and Kishore, 1990) during recent years. Flory's statistical theory has been utilized to estimate C_P and C_P^E in various binary liquids. Despite the large number of measurements on binary liquid mixtures, few studies have included pressure as an experimental variable, and in only very few cases these studies have been done at pressures other than atmospheric.

This work is a continuation of our studies on the evaluation of thermodynamic properties of binary liquid mixtures using Flory's statistical theory developed for elevated pressures (Pandey and Singh, 2013). In the present work, heat capacity at constant pressure (C_P), excess heat capacity (C_P^E), heat capacity at constant volume(C_V) and heat capacities ratio(γ), have been estimated for two binary mixtures using Flory's statistical theory at elevated pressures (0.1 MPa to 160 MPa) at 303.15K. The two binary liquid mixtures taken for the present investigation are: toluene+ o-xylene and toluene+ aniline.

THEORY

According to Flory's statistical theory (Flory, 1965), based on van der Waals potential energy model, the reduced equation of state is given by

$$\frac{\tilde{P}\tilde{V}}{\tilde{T}} = \frac{\tilde{V}^{1/3}}{\tilde{V}^{1/3}-1} - \frac{1}{\tilde{V}\tilde{T}} \qquad (1)$$

Eq. (1) has been solved to get expressions for the thermal expansion coefficient (α) and isothermal compressibility (β_T) under the restriction of pressure considerations.

Pressure dependent expressions are derived for the reduced volume $(\tilde{V})$ and reduced pressure $(\tilde{P})$ given as

$$\tilde{V} = \left[1 + \frac{\alpha T}{3(1-2\beta_T P+\alpha T)}\right]^3 \qquad (2)$$

and

$$\tilde{P} = \frac{\beta_T P}{(\alpha T-\beta_T P)} \frac{1}{\left[1+\frac{\alpha T}{3(1-2\beta_T P+\alpha T)}\right]^6} \qquad (3)$$

With the knowledge of thermal expansion coefficient and isothermal compressibility, we have calculated reduced volume $(\tilde{V})$ and reduced pressure $(\tilde{P})$ for pure components at elevated pressures with the help of eqs. (2) and (3).Using these values of $\tilde{V}$ and $\tilde{P}$, reduced temperature $(\tilde{T})$ has been calculated. Characteristic parameters are obtainedfrom their corresponding reduced parameters. With the help of these parameters, the expressions for various thermodynamic properties for binary liquid mixtures have been derived (Pandey and Singh, 2013), out of which the following eqs. have been used respectively to calculateC_P, C_P^E, C_V and γ of the binary liquid mixtures under consideration.

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[1] **Corresponding Author**

Heat capacity at constant pressure of the mixture is defined as,

$$C_p = C_p(idl.) + C_P^E \qquad (4)$$

where $C_P(idl.)$ is the ideal heat capacity of the mixture and is defined as

$$C_p(idl.) = \sum X_i \, C_{pi} \qquad (5)$$

C_{Pi} is the heat capacity of i^{th} pure component.

The excess heat capacity is defined by (Khanwalkar *et al.*, 1990) for binary mixtures as,

$$C_p^E = \frac{P^*V^*}{T^*}\left[\frac{1}{\left(\frac{4}{3}\tilde{V}^{-1/3}-1\right)} - \left\{\frac{X_1}{\frac{4}{3}\tilde{V}_1^{-1/3}-1} + \frac{X_2}{\frac{4}{3}\tilde{V}_2^{-1/3}-1}\right\}\right] \qquad (6)$$

The well-known thermodynamic relation for the heat capacities ratio is

$$\gamma = \frac{\beta_T}{\beta_S} \qquad (7)$$

and the heat capacity at constant volume of the mixture is calculated by the relation

$$C_V = \frac{C_p}{\gamma} \qquad (8)$$

The reduced and characteristic parameters, which are used in computation, have been deduced by the procedure mentioned earlier (Pandey and Singh, 2013). Thermal expansion coefficient and isothermal compressibility of pure components are obtained from empirical relations (Pandey *et al.*, 1997) where as isentropic compressibility and heat capacities at constant pressureare obtained using well- known thermodynamic relations.

RESULTS AND DISCUSSION

The two binary liquid mixtures taken for the present investigation are: toluene + o-xylene and toluene + aniline. Heat capacity at constant pressure, heat capacity at constant volume and heat capacities ratio have been evaluated using Flory's statistical theory at elevated pressures (0.1 MPa to 160 MPa) at 303.15 K. The calculated values for both the mixtures are compared with the experimental ones, and percentage deviations were calculated. Excess heat capacities of the liquid mixtures have also been reported. Since for the above-mentioned liquid mixtures, the experimental values of C_P, C_V and γ were not available, we have adopted an indirect method to get these values using well-known thermodynamic relations. The experimental values of ultrasonic velocity and density have been taken from the literature (Takagi and Teranishi, 1985).

Tables 1 and 2 enlist the calculated and experimental values of heat capacity at constant pressure along with the percentage deviations for the systems toluene + o-xylene and toluene + aniline respectively. Tables 3 and 4 record the values of excess heat capacity for mixtures toluene + o-xylene and toluene + aniline respectively. The experimental and calculated values of heat capacity at constant volume along with percentage deviations are reported in tables 5 and 6 respectively for toluene + o-xylene and toluene + aniline. In tables 7 and 8, the experimental and calculated values of heat capacities ratio along with percentage deviations at four mole fractions are reported respectively for toluene + o-xylene and toluene + aniline.

A close perusal of tables 1, 2, 5, 6, 7 and 8 reveals that calculated values of $C_P, C_V$and γ for both the mixtures show the same trend as experimental one. The values of C_P^E are, in general, negative for both the liquid mixtures. A close observation of tables 1 and 2 show that C_P increases as pressure increases at every mole fraction and at a constant pressure, $C_P$increases as the mole fraction of toluene in the mixtures decreases. For toluene + o-xylene, the maximum deviation is nearly five percent but, in most cases, it is less than one percent. But for toluene + aniline, the maximum percentage deviation is about ten. In this case percentage deviation increases as mole fraction of toluene in the mixtures decreases.

From tables 5 and 6, it is evident that variation in C_V with pressure and also with mole fraction show, in general, the same trend as C_P i.e., C_V increases when pressure is increased or the composition of toluene in the mixtures is decreased. Percentage deviations for C_V are greater than that for C_P. Percentage deviation increases as pressure increases for toluene + o-xylene but for toluene + aniline, this variation is not so straight forward but somewhat complex. A careful study of tables 7 and 8 reveals that value of γ decreases as pressure increases at every mole fraction for both the mixtures. But at a constant pressure when mole fraction is changed, an interesting result is seen for both the mixtures. The value of γ decreases as content of toluene decreases in the mixtures upto a certain pressure but it increases as toluene decreases after this certain pressure. This pressure is 30 MPa for toluene + o-xylene and 70 MPa for toluene + aniline. For both the mixtures percentage deviation increases with pressure and maximum percentage deviation is up to twenty for both the mixtures.

Table 1: Experimental and calculated values of heat capacity at constant pressure {Cp (J/Kmol)} of x-toluene + (1-x) o-xylene at 303.15 K along with percentage deviations

Pressure	x=0.8			x= 0.6			x = 0.4			x = 0.2		
(MPa)	Expt.	Cal.	% dev.	Expt.	Cal.	% dev.	Expt.	Cal.	% dev.	Expt.	Cal.	% dev.
0.1	157.68	158.23	-0.35	163.74	164.32	-0.35	169.46	170.40	-0.56	175.49	176.49	-0.57
10	164.62	164.81	-0.11	170.62	171.07	-0.27	176.51	177.34	-0.47	182.58	183.60	-0.56
20	170.91	170.81	0.06	177.49	177.17	0.01	183.50	183.52	-0.01	189.89	189.88	0.01
30	176.47	176.69	-0.13	183.18	183.18	0.00	189.49	189.67	-0.10	196.48	196.17	0 01
40	182.30	182.34	-0.02	189.06	189.13	-0.04	195.75	195.91	-0.09	202.62	202.70	-0.04
50	187.51	187.65	-0.07	194.21	194.52	-0.16	201.23	201.39	-0.08	208.48	208.26	-0.04
60	192.70	192.86	-0.09	199.73	194.51	2.61	206.73	201.38	2.59	213.53	208.26	2.47
70	197.22	197.17	0.02	203.91	194.51	4.61	211.49	201.38	4,78	21882	208.25	4.83
80	202.01	201.92	0.04	208.96	209.16	-0.10	216.22	216.41	-0.09	223.74	223.66	0.04
90	206.26	206.14	0.06	213.51	213.51	0.00	220.98	220.87	0.05	228.24	228.24	0.00
100	210.20	210.16	0.02	217.66	213.51	1.91	224.85	220.87	1.77	231.97	228.25	1.61
110	214.54	214.38	0.08	222.20	213.42	3.95	229.18	220.78	366	236.79	228.15	3.65
120	218.78	218.43	0.16	226.27	226.05	0.10	233.86	233.66	0.08	241.41	241.28	0.05
130	222.53	222.18	0.16	230.28	229.86	0.18	237.84	237.55	0.12	245.47	245.24	0.09
140	225.94	226.05	-0.05	233.72	229.86	1.65	241.83	237.55	1.77	249.12	245.25	1.55
150	229.42	229.66	-0.11	237.32	237.44	-0.05	245.08	245.23	-0,06	253.00	253.02	-0.01
160	233.04	233.11	-0.03	241.02	237.44	1.49	248.78	245.23	1.43	256.94	253.02	1.53

Table 2: Experimental and calculated values of heat capacity at constant pressure {Cp (J/Kmol)} of x-toluene + (1-x) aniline at 303.15 K along with percentage deviations

Pressure	x=0.8			x= 0.6			x = 0.4			x = 0.2		
(MPa)	Expt.	Cal.	% dev.	Expt.	Cal.	% dev.	Expt.	Cal.	% dev.	Expt.	Cal.	% dev.
0.1	157.68	158.23	-0.35	163.74	164.32	-0.35	169.46	170.40	-0.56	175.49	176.49	-0.57
10	164.62	164.81	-0.11	170.62	171.07	-0.27	176.51	177.34	-0.47	182.58	183.60	-0.56
20	170.91	170.81	0.06	177.49	177.17	0.01	183.50	183.52	-0.01	189.89	189.88	0.01
30	176.47	176.69	-0.13	183.18	183.18	0.00	189.49	189.67	-0.10	196.48	196.17	0 01
40	182.30	182.34	-0.02	189.06	189.13	-0.04	195.75	195.91	-0.09	202.62	202.70	-0.04
50	187.51	187.65	-0.07	194.21	194.52	-0.16	201.23	201.39	-0.08	208.48	208.26	-0.04
60	192.70	192.86	-0.09	199.73	194.51	2.61	206.73	201.38	2.59	213.53	208.26	2.47
70	197.22	197.17	0.02	203.91	194.51	4.61	211.49	201.38	4,78	21882	208.25	4.83
80	202.01	201.92	0.04	208.96	209.16	-0.10	216.22	216.41	-0.09	223.74	223.66	0.04
90	206.26	206.14	0.06	213.51	213.51	0.00	220.98	220.87	0.05	228.24	228.24	0.00
100	210.20	210.16	0.02	217.66	213.51	1.91	224.85	220.87	1.77	231.97	228.25	1.61
110	214.54	214.38	0.08	222.20	213.42	3.95	229.18	220.78	366	236.79	228.15	3.65
120	218.78	218.43	0.16	226.27	226.05	0.10	233.86	233.66	0.08	241.41	241.28	0.05
130	222.53	222.18	0.16	230.28	229.86	0.18	237.84	237.55	0.12	245.47	245.24	0.09
140	225.94	226.05	-0.05	233.72	229.86	1.65	241.83	237.55	1.77	249.12	245.25	1.55
150	229.42	229.66	-0.11	237.32	237.44	-0.05	245.08	245.23	-0,06	253.00	253.02	-0.01
160	233.04	233.11	-0.03	241.02	237.44	1.49	248.78	245.23	1.43	256.94	253.02	1.53

Table 3: Calculated values of excess heat capacity of x-toluene + (1-x) o-xylene at 303.15 K

Pressure	**C_P^E (J/Kmol)**			
(MPa)	**x = 0.8**	**x = 0.6**	**x = 0.4**	**x = 0.2**
0.1	0.0044	0.0053	0.0052	0.0044
10	0.0001	-0.0010	-0.0023	-0.0033
20	-0.0009	-0.0025	-0.0035	-0.0037
30	0.0002	-0.0023	-0.0036	-0.0034
40	-0.0021	-0.0051	-0.0060	-0.0043
50	-0.0038	-0.0066	-0.0068	-0.0040
60	-0.005	-0.0104	-0.0117	-0.0087
70	-0.0108	-0.0148	-0.0150	-0.0112
80	-0.0065	-0.0115	-0.0127	-0.0097
90	-0.0053	-0.0105	-0.0114	-0.0078
100	-0.0078	-0.0112	-0.0108	-0.0062
110	-0.0115	-0.0926	-0.0995	-0.1017
120	-0.0059	-0.0110	-0.0114	-0.0068
130	-0.0137	-0.0182	-0.0178	-0.0123
140	-0.0114	-0.0147	-0.0135	-0.0074
150	-0.0136	-0.0184	-0.0186	-0.0141
160	-0.0143	-0.0207	-0.0212	-0.0158

Table 4: Calculated values of excess heat capacity of x- toluene + (1-x) aniline at 303.15 K

Pressure	**C_P^E (J/Kmol)**			
(MPa)	**x = 0.8**	**x = 0.6**	**x = 0.4**	**x = 0.2**
0.1	0.0293	0.4850	0.6746	0.8375
10	0.0092	0.2251	0.3146	0.3957
20	-0.0055	-0.0130	-0.0174	-0.0150
30	-0.0140	-0.0175	-0.0167	-0.0045
40	-0.0220	0.1538	0.2358	0.3250
50	-0.0290	-0.0454	-0.0463	-0.0301
60	-0.0323	0.2939	0.4480	0.6094
70	-0.0446	-0.0670	-0.7455	-0.0636
80	-0.0414	-0.0532	-0.0477	-0.0195
90	-0.0436	0.2661	0.4169	0.5813
100	-0.0504	-0.0778	-0.0836	-0.0665
110	-0.0535	-0.1187	-0.1045	-0.0638
120	-0.0502	-0.0693	-0.0650	-0.0341
130	-0.0602	-0.0877	-0.0871	-0.0590
140	-0.0588	-0.0853	-0.0837	-0.0547
150	-0.0613	-0.0888	-0.8778	-0.0590
160	-0.0618	-0.0909	-0.0905	-0.0615

Table 5: Experimental and calculated values of heat capacity at constant volume {C_v(J/Kmol)} of x- toluene + (1-x) o-xylene at 303.15 K along with percentage deviations

Pressure	x=0.8			x=0.6			x = 0.4			x=0.2		
(MPa)	Expt.	Cal.	% dev.	Expt.	Cal	% dev.	Expt.	Cal.	% dev.	Expt.	Cal.	% dev.
0.1	111.17	111.60	-0.39	115.45	116.01	-0.49	119.48	120.43	-0.80	123.73	124.86	-0.91
10	116.40	118.95	-2.19	120.63	123.56	-2.42	124.79	128.17	-2.71	129.07	132.78	-2.87
20	121.17	125.96	-3.95	125.72	130.69	-3.96	130.32	135.42	-3.91	135.00	140.16	-3.82
30	125.42	132.89	-5.95	130.29	137.78	-5.75	134.90	142.67	-5.76	139.79	147.56	-5.56
40	129.87	139.66	-7.54	134.77	144.82	-7.46	139.67	149.98	-7.39	144.70	155.14	-7.21
50	133.87	146.21	-9.22	138.74	151,49	-9.19	143.88	156.77	-8.96	148.98	162.06	-8.78
60	137.86	152.70	-10.77	142.97	152.38	-6.58	148.11	157.58	-6.39	153.11	162.77	-6.31
70	141.36	158.61	-12.20	146.24	153.77	-5.15	151.80	159.08	-4.79	157.19	164.38	-4.57
80	145.06	164.80	-13.61	150.14	170.54	-13.59	155.46	176.27	-13.38	161.01	182.01	-13.04
90	148.37	170.67	-15.03	153.67	176.55	-14.89	159.16	182.44	-14.63	164.52	188.32	-14.47
100	151.45	176.41	-16.48	156.91	178.03	-13.46	162.20	184.02	-13.45	167.48	190.01	-13.46
110	154.82	18228	-17.74	160.43	179.13	-11.66	165.59	185.10	-11.78	171.22	191.07	-11.59
120	158.12	188.05	-18.93	163.62	194.33	-18.77	169.21	200.60	-18.55	174.81	206.86	-18.34
130	161.06	193.65	-20.24	166.75	200.05	-19.97	172.34	206.44	-19.79	178.00	212.83	-19.57
140	163.75	19932	-21.72	169.48	201.46	-18.87	175.47	207.93	-18.50	180.89	214.40	-18.53
150	166.50	204.85	-23.04	172.32	211.48	-22.73	178.06	218.10	-22.49	183.95	224.72	-22.16
160	169.34	210.31	-24.19	175.23	212.95	-21.52	180.98	219.50	-21.28	187.05	226.06	-20.86

Table 6: Experimental and calculated values of heal capacity at constant volume {C_v(J/Kmol)} of x-toluene +(1-x) aniline at 303.15 K along with percentage deviations

Pressure	x = 0.8			x= 0.6			x =0.4			x = 0.2		
(MPa)	Expt.	Cal.	% dev.	Expt.	(MPa)	Expt.	Cal.	% dev.	Expt.	(MPa)	Expt.	Cal.
0.1	117.83	116.54	1.1	129.61	0.1	117.83	116.54	1.1	129.61	0.1	117.83	116.54
10	122.35	123.33	-0.8	134.35	10	122.35	123.33	-0.8	134.35	10	122.35	123.33
20	126.8	129.88	-2.43	138.97	20	126.8	129.88	-2.43	138.97	20	126.8	129.88
30	131.12	136.33	-3.98	142.96	30	131.12	136.33	-3.98	142.96	30	131.12	136.33
40	135.48	142.57	-5.23	147.14	40	135.48	142.57	-5.23	147.14	40	135.48	142.57
50	139.33	148.72	-6.74	151.07	50	139.33	148.72	-6.74	151.07	50	139.33	148.72
60	143.28	154.61	-7.91	154.87	60	143.28	154.61	-7.91	154.87	60	143.28	154.61
70	146.7	160.36	-9.31	158.54	70	146.7	160.36	-9.31	158.54	70	146.7	160.36
80	150.39	166.2	-10.51	162	80	150.39	166.2	-10.51	162	80	150.39	166.2
90	153.55	171.74	-11.85	165.5	90	153.55	171.74	-11.85	165.5	90	153.55	171.74
100	157.03	177.26	-12.88	169.14	100	157.03	177.26	-12.88	169.14	100	157.03	177.26
110	160.25	182.74	-14.04	172.23	110	160.25	182.74	-14.04	172.23	110	160.25	182.74
120	163.46	188.2	-15.13	175.49	120	163.46	188.2	-15.13	175.49	120	163.46	188.2
130	166.12	193.5	-16.48	178.33	130	166.12	193.5	-16.48	178.33	130	166.12	193.5
140	169.36	198.88	-17.43	181.08	140	169.36	198.88	-17.43	181.08	140	169.36	198.88
150	171.93	204.12	-18.72	184.04	150	171.93	204.12	-18.72	184.04	150	171.93	204.12
160	174.77	209.22	-19.7	186.85	160	174.77	209.22	-19.7	186.85	160	174.77	209.22

Table 7: Experimental and calculated values of heat capacities ratio(γ) of x-toluene + (1-x) o-xylene at 303.15 K along with percentage deviations

Pressure	x = 0.8			x=0.6			x = 0.4			x =0.2		
(MPa)	Expt.	Cal.	% dev.	Expt.	(MPa)	Expt.	Cal.	% dev.	Expt.	(MPa)	Expt.	Cal.
0.1	1.418	1.418	0.03	1.418	0.1	1.418	1.418	0.03	1.418	0.1	1.418	1.418
10	1.414	1.386	2.04	1.414	10	1.414	1.386	2.04	1.414	10	1.414	1.386
20	1.410	1.358	3.85	1.409	20	1.410	1.358	3.85	1.409	20	1.410	1.358
30	1.407	1.33	5.5	1.406	30	1.407	1.33	5.5	1.406	30	1.407	1.33
40	1.404	1.306	6.99	1.403	40	1.404	1.306	6.99	1.403	40	1.404	1.306
50	1.401	1.263	8.37	1.400	50	1.401	1.263	8.37	1.400	50	1.401	1.263
60	1.398	1.263	9.64	1.397	60	1.398	1.263	9.64	1.397	60	1.398	1.263
70	1.395	1.243	10.9	1.394	70	1.395	1.243	10.9	1.394	70	1.395	1.243
80	1.393	1.225	12.02	1.392	80	1.393	1.225	12.02	1.392	80	1.393	1.225
90	1.390	1.208	13.12	1.389	90	1.390	1.208	13.12	1.389	90	1.390	1.208
100	1.388	1.191	14.17	1.357	100	1.388	1.191	14.17	1.357	100	1.388	1.191
110	1.386	1.176	15.13	1.385	110	1.386	1.176	15.13	1.385	110	1.386	1.176
120	1.384	1.162	16.05	1.383	120	1.384	1.162	16.05	1.383	120	1.384	1.162
130	1.382	1.147	16.96	1.381	130	1.382	1.147	16.96	1.381	130	1.382	1.147
140	1.380	1.134	17.8	1.379	140	1.380	1.134	17.8	1.379	140	1.380	1.134
150	1.378	1.121	18.64	1.377	150	1.378	1.121	18.64	1.377	150	1.378	1.121
160	1.376	1.108	19.46	1.375	160	1.376	1.108	19.46	1.375	160	1.376	1.108

Table 8: Experimental and calculated values of heat capacities ratio (γ) of x-toluene + (1-x) aniline at 303.15 K along with percentage deviations

Pressure	x=0.8			x= 0.6			x = 0.4			x= 0.2		
(MPa)	Expt.	Cal.	% dev.	Expt.	(MPa)	Expt.	Cal.	% dev.	Expt.	(MPa)	Expt.	Cal.
0.1	1.405	1.404	0.09	1.39	0.1	1.405	1.404	0.09	1.39	0.1	1.405	1.404
10	1.401	1.375	1.89	1.387	10	1.401	1.375	1.89	1.387	10	1.401	1.375
20	1.398	1.348	3.54	1.384	20	1.398	1.348	3.54	1.384	20	1.398	1.348
30	1.395	1.324	5.04	1.381	30	1.395	1.324	5.04	1.381	30	1.395	1.324
40	1.392	1.302	6.42	1.379	40	1.392	1.302	6.42	1.379	40	1.392	1.302
50	1.389	1.282	7.7	1.376	50	1.389	1.282	7.7	1.376	50	1.389	1.282
60	1.386	1.263	8.91	1.374	60	1.386	1.263	8.91	1.374	60	1.386	1.263
70	1.384	1.245	10.05	1.372	70	1.384	1.245	10.05	1.372	70	1.384	1.245
80	1.381	1.228	11.11	1.396	80	1.381	1.228	11.11	1.396	80	1.381	1.228
90	1.379	1.212	12.14	1.367	90	1.379	1.212	12.14	1.367	90	1.379	1.212
100	1.377	1.196	13.11	1.365	100	1.377	1.196	13.11	1.365	100	1.377	1.196
110	1.375	1.182	14.04	1.363	110	1.375	1.182	14.04	1.363	110	1.375	1.182
120	1.373	1.168	14.92	1.362	120	1.373	1.168	14.92	1.362	120	1.373	1.168
130	1.371	1.155	15.78	1.36	130	1.371	1.155	15.78	1.36	130	1.371	1.155
140	1.369	1.142	16.58	1.358	140	1.369	1.142	16.58	1.358	140	1.369	1.142
150	1.367	1.130	17.38	1.357	150	1.367	1.130	17.38	1.357	150	1.367	1.130
160	1.366	1.117	18.18	1.355	160	1.366	1.117	18.18	1.355	160	1.366	1.117

REFERENCES

Ahluwalia J.C., Bhat R. and Kishore N., 1988. Thermodynamic Studies of Transfer of some Ammino Acids and Peptides from Water to Aqueous Glucose and Sucrose Solution at 298.15K. J. Chem. Soc. Faraday Trans. I., **84**: 2651.

Ahluwalia J.C. and Kishore N., 1990. Partial Molar Heat Capacities and Volumes of Transfer of Nucleic Acid Bases, Nucleosides and Nucleotides from Water to Aqueous Solutions of Sodium and Calcium Chloride at 25°C. J. Soln. Chem., **19**: 51.

Ball L.A., Costas M., Paquet P., Patterson D. and Victor M.E.St., 1989. Heat Capacity and Structure in Strongly- Interacting Systems. Pure Appl. Chem., **61**: 1075.

Ball L.A., Patterson D., Costas M. and Caceres M., 1988. Heat Capacity and Corresponding States in alkan-1-ol-n-alkane Systems. J. Chem. Soc. Faraday Trans. I, **84**: 3991.

Costas M. and Patterson D., 1987. Order Destruction and Order Creation in Binary Mixtures of Non-Electrolytes. Thermochim. Acta., **120**: 161.

Dominguez A., Tardajos G., Aicart E., Perez- Casas S., Trejo L.M., Costas M., Patterson D. and Tra H., 1993. Van der Waals Liquids, Flory Theory and Mixing Functions for Chlorobenzene with Linear and Branched Alkanes. J. Chem. Soc. Faraday Trans, **89**: 89.

Flory P.J., 1965. Statistical Thermodynamics of Liquid Mixtures. J. Am. Chem. Soc., **87**: 1833.

Khanwalkar M.S., Murty J.S. and Deshpande D.D., 1990. Ultrasonic Velocity in Binary Liquid Mixtures. Acoust Lett., **13**: 121.

Pandey J.D., Dubey G.P., Tripathi N. and Singh A.K., 1997. Evaluation of Internal Pressure of Multicomponent Liquid Mixtures Using Velocity and Density Data.J. Int. Acad. Phy. Sci., **1**: 117.

Pandey J.D. and Singh V.K., 2013. Theoretical Formalism of Thermodynamic Properties of Liquid Mixtures on the basis of Flory’s Statistical Theory- Pressure Dependent Studies. Ind. J. Sci. Res., **4**(**2**):257.

Takagi T. and Teranishi H., 1985.Ultrasonic Speed and Thermodynamics of (toluene+ o-xylene) and (toluene+ aniline) Under High Pressure. J. Chem. Therm., **17**: 1057.

Van H. and Patterson D., 1982. Volumes of Mixing and the P^*Effect: Part I. Hexane Isomers with Normal and Branched Hexadecane. J. Soln. Chem., **11**: 793.