Journal of Namibian Studies, 35 S1 (2023): 1563-1574 ISSN: 2197-5523 (online)

Excess Molar Volumes & Viscosity Deviation Of LiquidMixtures Ofn, N Dimethyl Aniline&N, N Diethyl Aniline In 1- Propanol & 1- Butanol

Dr. Ansari Farzana W

Assistant Professor J.A.T. Arts, Science and Commerce College
(For Women), Malegaon, India

Abstract:

The values of density & viscosity for the binary liquid mixtures of N,N diethyl aniline & N,N diethyl aniline with alkanols (1-propanol & 1- butanol) have been measured over a entire range of composition at T=298k to 313k. Using these, excess molar volumes (V^E) & deviations in viscosity have been correlated with the Red lich — kister type polynomial equation to derive the binary coefficients & standard deviations.

Introduction:

Experimental viscosities provide information on the structures of liquids & are required in the design processes which involve mass transfer, fluid flow, etc. the thermodynamic properties of solvents, suchas density (९) & viscosity (η), which are two imp. Physical properties of solvent systems & are often used to explain the medium effect of solvent on transport phenomenon. These properties are functionally dependent on temp. &, at least for binary mixtures, on the component of solvent system. The change in these properties with mole fraction often provides more detailed evidence about the structural character of the systemthemselves.

Alcohols are strongly self-associated molecules through hydrogen bonding &for binary solutions rich in alcohols , threedimensional network of hydrogen bond is believed to be present , substituted anilines also exist as associated structure in liquid state Alcohol is proton donating and aniline is proton accepting molecules.The molecules , N,N Dimethyl aniline (DMA) & N,N Diethyl aniline (DEA) has many industrial applications , of which , DMA is key precursor to commercially important triarylmethane dyes have specific association with alcohols & they have interesting solvent properties , thus upon mixing these anilines with alcohols of varying chain length & branching interesting properties due to specific interaction arising from the charge transfer , dipole — dipole , donor — acceptor & hydrogen bond informationforces may be observed .In view of this we report here in the density & viscosity data for the 4 binary systems formed by 1-propanol & 1- butanol with DMA &DEA at atmospheric pressure over the entire composition range at temper. T=298k to 313k. These result have beenused to calculate excess volume& deviations in viscosity.

Experimental:

N, N Dimethyl aniline (99.5% pure) & N, N Diethyl aniline (99.5% pure) procured from S.D fine chemicals Ltd. India were used after single distillation. 1- Propanol (99% pure) & 1-butanol (99.5% pure) were purchased from S.D fine chemicals Ltd. India. These samples were usedafter single distillation. The purities of solvents were further ascertained by etc. & comparing their densities & viscosities at T= 298k, which agreed reasonably with corresponding reported values(Table 1).

Table – 1: Comparison of Experimental densities (ρ / g.cm^{-3}) & viscosities (η /mpa.S) of pure liquids at different temp. With literature data.

Component	ρ (g cm^{-3})		η (mpa.S)	
	Expt.	Lit.	Expt.	Lit.
		298k		
N,N DMA	0.9523	0.9522	1.288	1.282
N,N DEA	0.9302	0.9307	1.935	1.933
1-Propanol	0.7997	0.7997	1.944	1.943
1-Butanol	0.8057	0.8058	2.570	2.571

Binary mixtures were prepared loy mass in air — tight glass bottles. The mass measurements were performed on a Dhona 160 D (India) single pan analytical balance, with a precision of 0.01mg. The required properties were measured within a day of preparing the mixture. The possible error in maple fraction is estimated to be less than ± 1 x 10^{-4}.

Densities of pure liquids and their mixtures were determined by using conductivity water with 0.99795 cm^{-3} as its density at 298:15 k.The uncertainty in density & excess molar volume values is found to be
± 0.00005 gcm^{-3}& ± 0.001cm^{3}mol^{-1} respectively.

Ubbelonde viscometer having a capacity of about 15ml was used to measure the How times of pure liquids & liquid mixtures. The dynamic viscosities were measured using this viscometer with an electronic stop watch with readability of

±0.015s for flow time measurement.

The flow time measurement was repeated number of time (usually 5-6 times). The different reading di note deviate from the mean by more than 0.2s& the results were arranged. since all flow times were greater than 200s& capillary radius (0.5mm) was far less than its length (50 to 60 mm) , the kinetic energy & end correction , respectively , were foundto be negligible viscosity value (ɳ) of pure liquids & mixtures were calculated using the relation ,

ɳ = (a t^{b}
t
)ϱ ---------1

Where ‘a’ & ‘b’ represent the characteristics constants of the viscometer, ϱ is the density & the flow time. The uncertainty in viscosity
& viscosity deviation values was found to be ± 0.001 mpa.s & ±0.005 mpa.s respectively.

Table -2: The values of excess molar volumes (V^E /$cm^3.mol^{-1}$) & deviation in viscosity (Δɳ / $g.cm^{-1}S^{-1}$) for the binary liquid mixtures of N,N , Dimethyl aniline (1) with alkanols (2) at different temp.

X_1	V^E /$cm^3.mol^{-1}$				Δɳ / $g.cm^{-1}$ S^{-1}			
	298k	303k	308k	313k	298k	303k	308k	313k
N, N Dimethyl aniline (1) + 1-propanol (2)								
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.522	1.0120	1.1965	1.3779	1.5643	0.1053	0.0776	0.0613	0.0463
0.1227	0.4673	0.6934	0.9098	1.0708	0.0575	0.0392	0.0284	0.0171
0.1935	-0.0931	0.2071	0.4712	0.6284	0.0169	0.0040	-0.0074	-0.0191
0.3351	-0.3014	-0.1696	-0.0103	0.1572	-0.0162	-0.0264	-0.0359	-0.0443
0.4773	-0.4286	-0.3218	-0.1820	-0.0556	-0.0289	-0.0375	-0.0472	-0.0583
0.5479	-0.3101	-0.1546	-0.0357	0.1663	-0.0146	-0.0258	-0.0351	-0.0435
0.6188	-0.0948	-0.2289	-0.4286	0.6411	0.0200	0.0041	0.0068	-0.0165
0.7622	0.4916	0.6947	0.8823	1.0715	0.0570	0.0367	0.0265	0.0130
0.9041	1.0590	1.1925	1.3390	1.5827	0.1041	0.0794	0.0620	0.0459
1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

N, N Dimethyl aniline (1) + 1-butanol (2)								
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0542	-0.0390	-0.0228	-0.0129	-0.0050	0.0976	0.0774	0.0499	0.0300

0.1061	-0.0639	-0.0424	-0.0222	-0.0178	0.0721	0.0432	0.0258	0.0072
0.2077	-0.0746	-0.0528	-0.0347	-0.0247	0.0355	0.0134	-0.0044	-0.0130
0.3091	-0.0739	-0.0508	-0.0343	-0.0178	0.0056	-0.0075	-0.0167	-0.0253
0.4106	-0.0661	-0.0408	-0.0255	-0.0141	-0.0032	-0.0114	0.0210	-0.0286
0.5128	-0.0490	-0.0209	-0.0063	0.0130	0.0050	-0.0014	-0.0167	-0.0273
0.6139	-0.0058	0.0136	0.0279	0.0431	0.0337	0.0123	-0.0053	-0.0149
0.7156	0.0548	0.0659	0.0802	0.0917	0.0671	0.0416	0.0236	0.0070
0.8177	0.0497	0.0650	0.0791	0.0866	0.0961	0.0764	0.0488	0.0282
1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table - 3 : The values of excess molar volumes (V^E /$cm^3.mol^{-1}$) &deviation in viscosity (Δɳ / $g.cm^{-1}S^{-1}$) for the binary liquid mixtures of N,N , Diethyl aniline (1) with alkanols (2) at different temp.

X_1	V^E /$cm^3.mol^{-1}$				Δɳ / $g.cm^{-1}$ S^{-1}			
	298k	303k	308k	313k	298k	303k	308k	313k
N, N Diethyl aniline (1) + 1-propanol (2)								
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.1012	-0.0713	-0.0516	-0.0347	-0.0191	0.065	0.060	0.051	0.033
0.2009	-0.1123	-0.1002	-0.0737	-0.0501	0.043	0.030	0.014	-0.007
0.3012	-0.1468	-0.1301	-0.1037	-0.0700	0.025	0.005	-0.010	-0.024
0.4016	-0.1422	-0.1185	-0.0914	-0.0580	0.010	-0.010	-0.022	-0.035
0.5016	-0.1250	-0.0925	-0.0642	-0.0307	0.005	-0.015	-0.024	-0.036
0.6017	-0.0691	-0.0394	-0.0098	0.0243	0.008	-0.010	-0.020	-0.033
0.7020	0.0080	0.0350	0.0665	0.1015	0.020	0.005	-0.009	-0.022
0.8023	0.0782	0.1027	0.1361	0.1559	0.041	0.030	0.017	-0.004
0.9024	0.0668	0.0879	0.1225	0.1417	0.062	0.059	0.050	0.032
1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

N,N diethyl aniline (1) 1- Butanol (2)								
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.1013	-0.0549	-0.0448	-0.0361	-0.0204	0.0413	0.0324	0.0196	0.0064
0.2014	-0.1002	-0.0771	-0.0580	-0.0363	0.0209	0.0121	-0.0044	-0.0147
0.3013	0.1176	-0.0918	-0.0739	-0.0581	0.0043	-0.0102	-0.0195	-0.0288
0.4041	-0.1146	-0.0844	-0.0670	-0.0426	-0.0101	-0.0204	-0.0304	-0.0399
0.5015	-0.0938	-0.0576	-0.0405	0.0204	-0.0135	-0.0237	-0.0374	-0.0439
0.6016	-0.0497	-0.0058	0.0266	0.0582	-0.0090	-0.0179	-0.0283	-0.0390
0.7017	0.0498	0.0877	0.1057	0.1345	0.0036	-0.0052	-0.0143	-0.0271
0.8018	0.1372	0.1692	0.1879	0.2140	0.0181	0.0095	0.0017	-0.0102
0.9019	0.1164	0.1414	0.1600	0.1824	0.0347	0.0253	0.0188	0.0128
1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

In all of the property measurements, the temp. Was controlled within ±0.01k using a constant temp bath (INSREF model IRI-016C, India)

Result & Discussion:

The values of density & viscosity of binary mixtures of DMA & DEA with 1-propanol & 1-Butanol at T= 298k to 313k along with the mole fraction are given in the tables 2 & 3.

The excess molar volumes (V^E) have been evaluated from density using,

$$V^E = V_m - (X_1V_2 + X_2V_2) \text{ --- } 2$$

$$V_m = (X_1M_1 + X_2M_2) / \rho_m \text{ -- } 3$$

Where V_m and ρ_m are the molar volume and density of the mixture,

X_1, V_1, M_1, and X_2, V_2, M_2 are the mole fraction, molar volume and molecular weight of pure components 1 and 2 respectively. The deviation in viscosity is calculated using the relation;

$$\Delta\eta = \eta_m - (X_1 \eta_1 + X_2\eta_2) \text{ -- } 4$$

Whereη_m,η_1 and η_2 are the pure viscosities of the liquid mixtures & of the pure components 1 and 2 respectively; X_1&X_2 are the mole fractions of the pure components, 1 & 2 in the liquid state.

The excess properties y^E are filled by the method of non-linear least squares to a Redlich - Kister type polynomial;

$y^E = X_1X_2\Sigma\ Ai\ (X_1 - X_2)^i$ -- 5

In each of case, the optimum number of coefficients Ai was determinedfrom an examination of variation of standard deviation (ð) as calculated by;

$$ð\ (y^E) = [\ \Sigma\ \frac{\overline{(y^E obs - y^E\ Cal)^2}}{n-m}\ ]^{\frac{1}{2}} \text{----------------------------- } 6$$

Where n represents the number of experimental points and m is the number of coefficients used in fitting the data. The estimated values of Ai&ð for V^E&Δɳ are given in the Tables 4 and 5. In all cases, the best fit was found by using fine adjustable fitting coefficients in equation (5).

Excess molar volume (V^E):

The data included in Table 2 shows that excess molar volumes V^E are more negative at low temp. & DMA with 1-proponal. The V^E values for the binary mixtures of DMA + 1-Butanol shows more negative peaks at low temp. & more positive peaks at high temp. Variation of excess molar volumes V^E versus mole fraction (X_1) of binary mixtures of DMA +1 propanol & 1 Butanol is depicted in fig.1.

The data included in Table 3 shows that excess molar volumes V^E are negative in lower mole fraction values for all DEA + 1-propanol & DEA + 1-butanol binary systems, which further decreases at higher temperatures that is positive V^E increases. Variation of excess molar volumes V^E versus mole fraction (X_1) of the binary liquid mixtures of DEAwith 1-propanol & 1- butanol is depicted in the fig.2.

The observed values of excess molar volumes in the present investigation may be explained in terms of several effects, which may arbitrarily be divided into physical, chemical & geometrical contributions. Treszcanowiczet al[15]& Amina bhavi et al[16] suggested that the V^E is the resultant contribution from several opposing effects.

Table - 4 : The binary coefficients (Ai) & standard deviation (ð) of N, N Dimethyl aniline with alkanols at different temperatures.

Property	Temp.(k)	A_0	A_1	A_2	A_3	A_4	A_5	ð
N,N Dimetyl aniline(1) +1-propanol (2)								

V^E(cm3. mol-1)	298	-1.0635	-1.6106	-3.4838	36.6333	32.9975	-48.183	0.1557
	303	-0.4122	-0.2813	-1.7763	31.4658	34.0369	-45.4	0.2224
	308	0.1666	-0.2945	-0.1325	31.9106	35.2790	-47.504	0.2531
	313	0.9386	-0.4520	-1.3133	35.1573	41.2330	-51.377	0.3000
oɳ(9.cm-1)	298	0.0110	-0.0519	1.0876	3.4726	-0.1700	-6.2302	0.0150
	303	-0.0370	-0.2060	0.8160	4.0052	-0.1486	6.3954	0.0160
	308	-0.0778	-0.1089	0.5820	2.7533	-0.0957	-4.4043	0.0082
	313	-0.1156	-0.0826	0.5677	2.1800	-0.6178	-3.7109	0.0074

N,N Dimethyl aniline (1) + 1-Butanol (2)								
V^E(cm3. mol-1)	298	-0.2184	0.5534	1.4404	1.3600	-2.7612	-2.6892	0.0032
	303	-0.1087	0.5029	1.1226	1.2253	-1.8800	-2.2641	0.0032
	308	-0.0480	0.5552	1.1172	0.6828	-1.4928	-1.4869	0.0042
	313	0.1681	-0.5424	-5.3364	4.3354	29.3176	21.3653	0.0529
oɳ(9.cm-1)	298	-0.0349	-0.0460	-0.2593	2.8516	3.1183	-4.0628	0.0212
	303	-0.0349	-0.0460	-0.2593	2.8516	3.1183	-4.0628	0.0212
	308	-0.1339	0.0724	-0.0177	1.5706	1.8521	-2.3828	0.0130
	313	-0.1759	0.1238	0.0199	1.1087	1.4729	-1.8132	0.0121

Table : 5 — The binary coefficient (Ai) & standard deviation (ð) of N,NDiethyl aniline with alkanols at different temperatures.

Property	Temp.(k)	A_0	A_1	A_2	A_3	A_4	A_5	ð
N,N Diethyl aniline (1) + 1- propanol (2)								
V^E(cm3. mol-1)	298	0.5084	0.7407	1.4225	1.1494	-1.0060	-1.2562	0.0060
	303	-0.3828	0.7902	1.579	1.3143	-0.3428	-1.6081	0.0052
	308	-0.2703	1.8347	1.2806	1.1065	-0.1110	-1.0867	0.0054
	313	-0.1239	0.8799	1.2247	0.7748	0.0811	-0.6013	0.0031
oɳ(g.cm-1)	298	0.0294	-0.0512	0.1808	0.1695	1.3634	-0.1823	0.0031
	303	-0.0486	-0.0081	0.1277	0.0487	1.5274	-0.1823	0.0031
	308	-0.0872	0.0046	-0.0852	0.0282	1.7079	-0.0693	0.0026
	313	-0.1311	0.0041	-0.2672	0.0513	1.6071	-0.1235	0.0050

N,N Diethyl aniline (1) + 1-butanol (2)							
V^E(cm3. mol-1)	298	-0.4019	0.5823	1.6754	2.9124	-0.7606	-3.0565	0.0050
	303	-0.2540	0.7347	1.7209	2.3278	-0.7169	-2.2556	0.0048
	308	-0.1683	0.8583	1.7723	1.5859	-0.6383	-1.2245	0.0061
	313	-0.0691	0.9612	1.8663	1.1987	-0.5114	-0.7529	0.0080
oη(9.cm-1)	298	-0.0467	0.0062	0.1923	-0.0562	0.8391	-0.0403	0.0028
	303	-0.0899	0.0494	0.1977	-0.2063	0.6911	0.0775	0.0014
	308	-0.1336	0.0145	0.1631	0.1289	0.5876	-0.2549	0.0034
	313	-0.1679	0.0041	0.0678	0.0210	0.5592	0.0581	0.0022

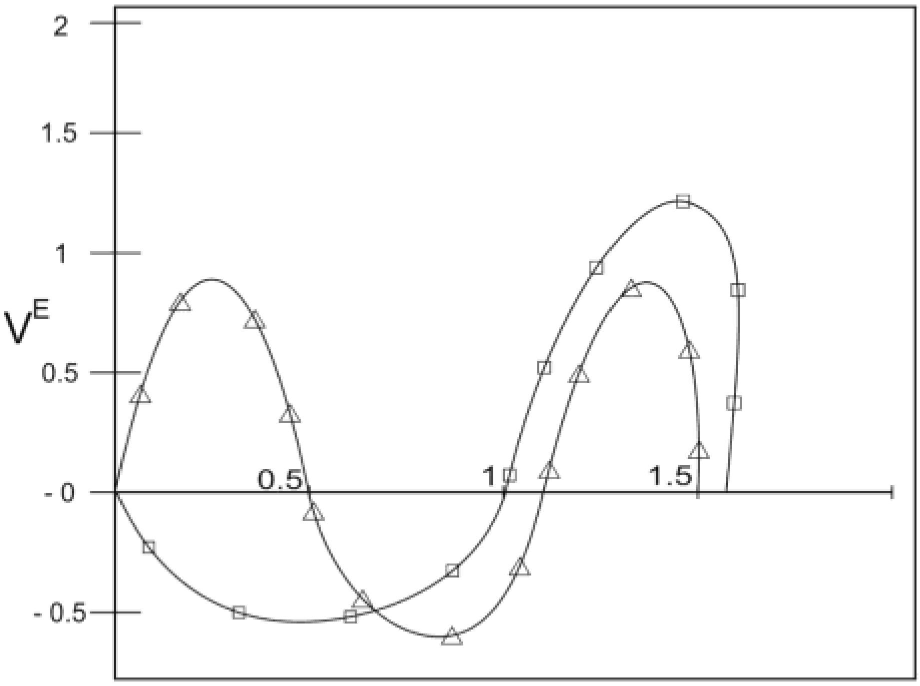

Fig : 1Variation of Excess molar volume V^EVs mole fract^n (X_1) of the binary mix.of (Δ) DMA + 1-propanol & (□) DMA +1-Butanol at the temp. 303k.

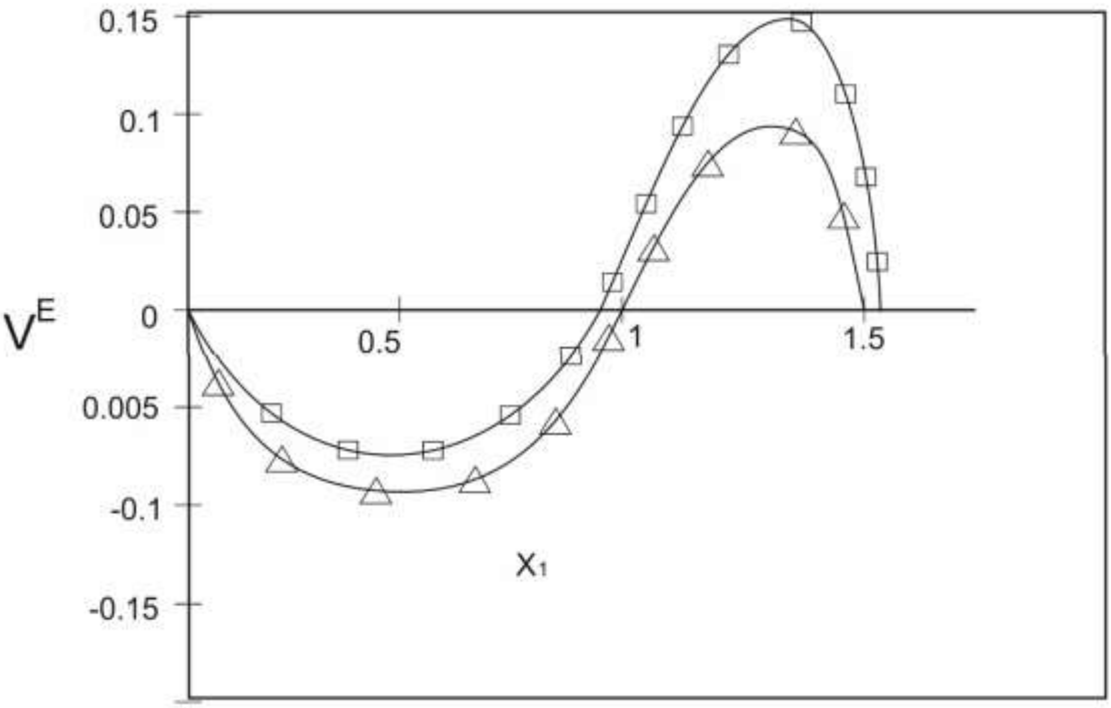

Fig : 2

Variation of Excess Molar volume (V^E) Vs mole fract^n (X_1) of the binary mix. of DEA (Δ) + 1-propanol & (⍰) DEA + 1- Butanol at temp. 303k.

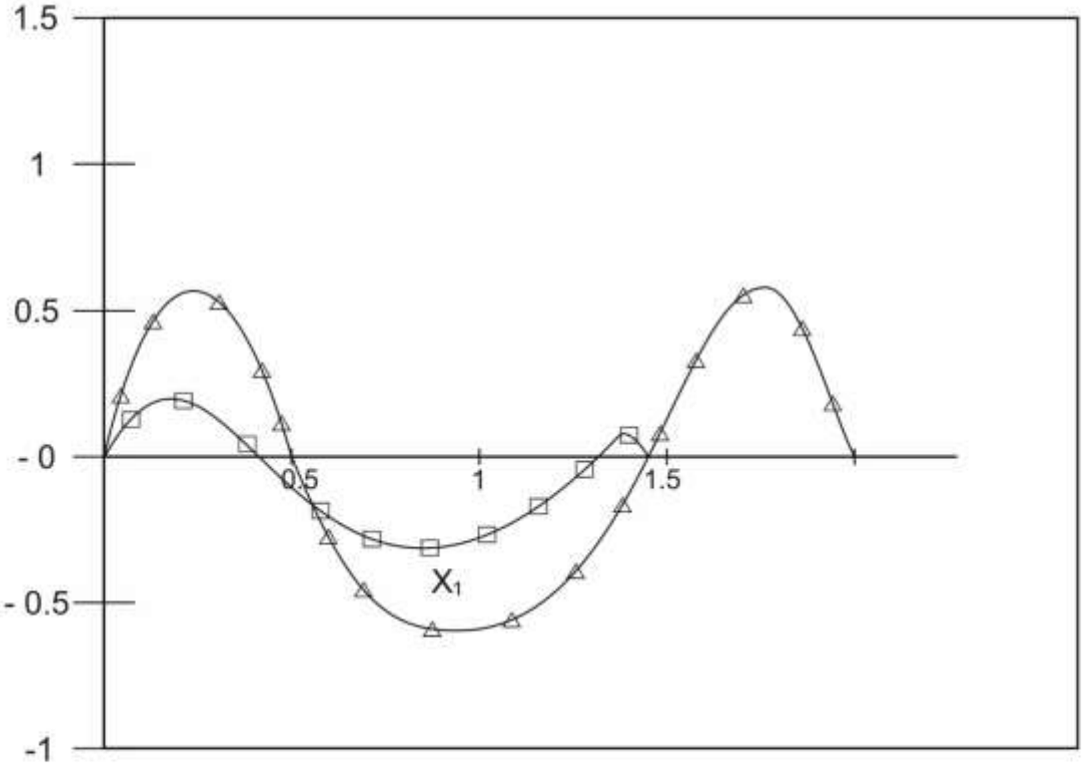

Fig : 3

Variation of Excess molar volume Δη Vs mole fract^n (X_1) of the binary mix.of (Δ) DMA + 1-propanol & (⍰) DMA +1-Butanol at the temp. 303k.

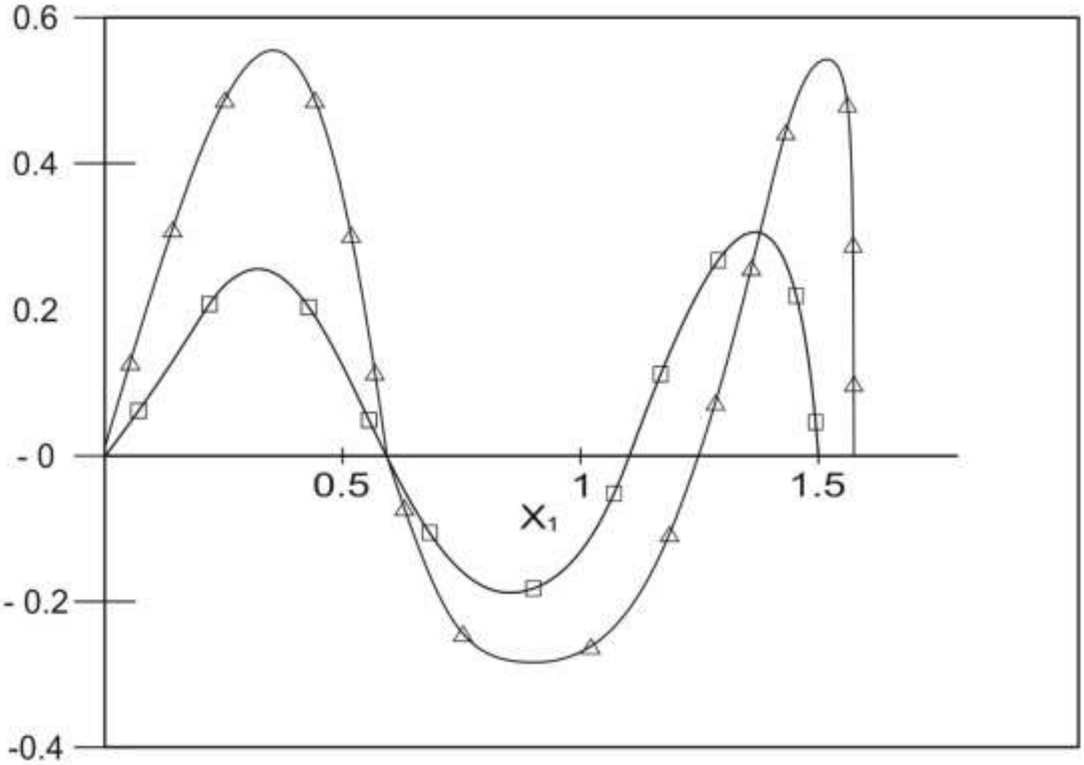

Fig : 4 Variation of Excess Molar volume ΔηVs mole fract^n (X_1) of the binary mix. of DEA (Δ) + 1-propanol & (⍰) DEA + 1- Butanol at temp. 303k.

Viscosity Deviation (Δη):

The data included in the Table 2 & 3 show that Δη values for mixtures DMA + 1- propanol are positive in lower & higher concentration ranges & negative in intermediate concentration region (X_1 = 0.1935 to 0.6188) . In case of mixtures DMA + 1-butanol Δη values at lower & higher concentration are positive & negative in intermediate concentration region (X_1 = 0.2077 to 0.6139).

The plots of οη versus X1 shows the variation with temp. in fig. 3 & 4.The Δη values for the mixture DEA + 1- propanol are negative at concentration of DEA ranging between (0.2 to 0.8) mole fraction & positive between $X_1 < 0.2$ & $X_1 > 0.8$. Same as in case of DEA + 1 — Butanol binary mixtures system. The positive Δη values are attributed to strong intermolecular interactions. However, there is general decrease in viscosity deviation with increasing temp.

The correlation between the sign of Δɳ& V^E has been observed for a number of binary solvent system, Δɳ being negative whereas V^E positive or vice versa. The observed data of V^E&Δɳ do not go by the general rile. For such system, Rastogi et al[18], suggested that the observed excess property is a combination of an interaction & non — interaction part thus we can safely say;

Y^E(observed) = Y^E (interaction) + Y^E (size effect)

Where Y^Erefers to the excess of deviation in the property. The non — interaction part in the form of the size effect can be comparable tointeraction part. Based on this theory, the observed incongruity may be accredited to the size effect. The molecular interaction between the binary solvent systems appear to be dominating physical forces.

References:

1. Marcus Y. "Introductin to liquid state chemistry", Willey.New York,1977.
2. Rice S.A. and Gray P. "The Statistical Mechanics of Simple Liquids".Interscience, New York, 1965.
3. Glasstone S., Lardler KJ. and Eyring H, "The Theory of RateProcesses," McGraw Hill, New York, 1942 Chapter 9.
4. Rosevare W. E., Powell R. E. and Eyring H,J Appl. Phys,12(1941)669.
5. Krishna M.R. V and Laddha G.S., IndEngChem, Fundam,7 (1968)324.
6. Doolittle A.K. J Appl. Phys., 22 (1951) 1471.
7. Williams M.L., Landel R.F. and Ferry J D., J. Am ChemSoc, 77 (1955) 3701.
8. Cohen M.H. and Turnbull D., J. Chem, Phys, 31 (1959) 1164.
9. Macedo PB. andLitovitz TA., J. Chem, Phys, 42 (1965) 245.
10. Flory PJ.,Orwall R.A. and Vrij A., J. Am. Chem., Soc, 86(1964)3507, 3515.
11. Flory PJ,OrwallRA.andVrijA.JAm. Chem, Soc.87 (1965) 1833.
12. Abe A. and Flory P.J., J. Am. Chem, Soc. 87 (1965) 1838.
13. Prigogine 1, "The Molecular Theory of Solutions," North HollanPublishing Company, Amsterdam, (1957).
14. Powell R., Eyring H, Industrial Eng Chem., 33 (1941) 432.
15. Katti P.K. and Choudhari M.M., J Chem. Eng Data, 9 (1964) 443.
16. Moore W.R., Styan G.E., Trans Faraday Soc, 52 (1956) 1556.

17. Hind R.K., Massengil D.R. and Ubbelhode A.R., Trans Faraday Soc., 56 (1960) 328.
18. Kendall J and Monoroe K.P., J. Am Chem Soc., 39 (1917) 1787.
19. Dolezalek F., Z Phys. Chem, 83 (1987).
20. Powell R.E., Rosevare W.E. and Erying H., Industrial EngChem 33 (1944) 430.
21. Kottler F., J. Phys. Chem, 47 (1943) 277,48. (1944) 76.
22. Tamura M. and Kurata M., Bull Chem., Soc., Japan, 25 (1952) 32.
23. Grunberg L. and Nissan A.H., Nature, 164 (1949) 799.
24. Andrade E.N., Phil Mag, 17 (1934) 698.25. Frankel Y.I., Z Phys, 35 (1926) 662. 26. Friend, Z Phys, 31 (1935) 542.
27. Mcleed, Z Phys, 19 (1923) 6.28. Ward, Z Phys, 33 (1937) 92.
29. McAllister R.A., AICHEJ, 6 (1960) 427.
30. Auslander G.B., Chem., Eng. Data, 9 (1964) 610.
31. Heric E.L., J Chem., Eng. Data, 11 (1966) 66.
32. Heric E.L., Brewer J.G., J. Chem., Eng. Data, 12(1967) 514.
33. Frank F., Desnoyers J.E., In Water Sci. Review, F. Franks Ed, Cambridge University, Cambridge, 1 (1985) 171.
34. Garg S.K., Banipal T.S. and Ahluwalia J.C., J. Chem., Eng. Data,38 (1990) 2106.
35. Aminabhavi V.A, Aminabhavi T.M. and Balundgi R.H, Ind, Eng. Chem., Res., 29 (1990) 2106.
36. Aminabhavi T.M., J. Chem., Educ., 60 (1983) 117.
37. Joshi S. Aminabhavi TM. and Shukla S.S, Can.J.Chem,68(1990) 251.
38. Aralguppi M.I., Aminabhavi T.M., Balundgi R.H. and Joshi S.S., J.Phys. Chem., 95 (1991) 5299.
39. Aminabhavi T.M. Joshi S.S., Balundgi R.H. and Shukla S.S, Can J. Chem, 69 (1991) 1028.
40. Rao M.V.P. and Naidu P.R., Indian J. Chem., 15A (1977) 239.
41. Rao M.V.P. and Naidu P.R., Indian J. Tech., 11 (1973) 242.
42. Papaloannou D., Evangelou T. and Panayiotou C.J. Chem., Eng. Data, 36 (1991) 43.
43. Teja A.S. and Rice P., Indian Eng. Chem., Fundum, 20 (1981) 77.
44. Crabtree A.M. and Brien J.E.O. J. Chem., Eng. Data, 36 (1991) 140.
45. Rao L.R., Satyanarayan N. and Sundaram E. V., Indian J. Chem, 29A (1990) 174.
46. Papanstasious G.E. and Ziogas I, J. Chem., Eng. Data, 36 (1991)46.
47. Petrosa G.C., Solas J.A., Davollio F. and Kartz M., AnAsoc. Quim Argent, 72 (1984) 541.
48. Mato F. and Coca J., An Quim, 68 (197) 17.Femeglia M. and La