International Journal of Multidisciplinary Research and Development 2014; 1(7): 455-459

International Journal of Multidisciplinary Research and Development

IJMRD 2014; 1(7): 455-459
www.allsubjectjournal.com
Received: 09-10-2014
Accepted: 12-11-2014
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 3.762

Dr. Gurcharan Dass
Jan Nayak Ch. Devi Lal Memorial College of Engineering, Sirsa, Haryana, India.

Correspondence:
Dr. Gurcharan Dass
Jan Nayak Ch. Devi Lal Memorial College of Engineering, Sirsa, Haryana, India.

Deviation in viscosities as a function of composition for binary liquid mixtures of ethyleneglycol monomethyl ether, diethyleneglycol monomethyl ether, diethyleneglycol monoethyl ether, diethyleneglycol monobutyl ether, triethyleneglycol monomethyl ether,diethyleneglycol diethyl ether and diethyleneglycol dibutyl ether all with propylamine at 298.15K and atmospheric pressure

Dr. Gurcharan Dass

Abstract
Composition dependence of deviation in viscosities for the binary mixtures ofethyleneglycol monomethyl ether, diethyleneglycol monomethyl ether, diethyleneglycol monoethyl ether, diethyleneglycol monobutyl ether, triethyleneglycol monomethyl ether, diethyleneglycol diethyl ether and diethyleneglycol dibutyl ether, all with propyl amine. From the data, deviations in viscosities for viscous flow have been calculated. These calculations are fitted to various equations to estimate the binary coefficients. The results for $\Delta\eta$ and in $\Delta\eta$ are discussed on the basis of molecular interaction between the components of the mixtures.
The results of $\Delta\eta$ are discussed on the basis of molecular interaction between the components of the mixtures. The aim of this work is to provide a set of values for the characterization of the molecular interactions of these mixtures and to examine effect of the enlargement of –CH2– unit in branched ether.

Keywords: ethyleneglycol monomethyl, diethyleneglycol monomethyl, triethyleneglycol monomethyl

Introduction
The study of thermodynamic properties of binary liquid mixture has proved to be a useful tool in elucidating the structural interactions among the components. Excess thermodynamic functions are of great importance to a chemical engineer in the design of industrial separation processes and to a chemist for arriving at theories of liquid mixtures. In principal, the interaction between the molecules can be establish from a study of characteristic abrupt departure from ideal behavior of some physical properties like volume, compressibility, viscosities etc.
Approximate approaches of Calculating Viscosity
The deviations in viscosity from a linear dependence on mole fraction average is given by expression, Equation (1.1).

$$\Delta\eta = \eta_{m^-}\left(\sum_{i=1}^{2}\eta_i x_i\right) \qquad (1.1)$$

Where x_i, η_i and η_m refer respectively to the mole fraction and viscosities of pure components and of the mixtures. Sometimes in literature the viscosities deviations are given by expression II, Equation (1.2)

$$\Delta\eta = \eta_m - \ln^{-1}\left(\sum_{i=1}^{2} x_i \ln\eta_i\right) \qquad (1.2)$$

In other instances, the deviation in the viscosity has been expressed in the form of expression III, Equation (1.3).

$$\text{Ln} \quad \Delta\eta = \ln\eta_m - (\sum_{i=1}^{2} x_i \ln\eta_i) \qquad (1.3)$$

Recently, the term deviations in the viscosity has been expressed by Equation (1.4).

$$\Delta\eta = \eta_m - \eta^{id} \qquad (1.4)$$

$$\text{Where in } (\eta^{id}M/\rho^{id}) = \sum x_i \text{In}(\eta M/\rho_i) \qquad (1.5)$$

$$\text{With} \rho^{id} = \sum x_i M i / \sum x_i v_i^{+} \qquad (1.6)$$

Where x_i is the mole fraction of component i, M the molecular weight of the mixture, ρ_i density of the component i, v_i the molar volume of component, and η_i the dynamic viscosity of component i, and η^{id} the viscosity as defined in Equation (1.5).

Table 1: Deviation in viscosities for ethyleneglycol monomethyl ether with propylamine mixtures calculated from data given by Pal *et al*. (1-7) at 298.15K and atmospheric pressure

Δη/m Pas					
X	**ηmix**	**Δη1 from equation 1.1**	**Δη2 from equation 1.2**	**lnη3 from equation 1.3**	**Δη4 from equation 1.4**
ethyleneglycol monomethyl ether(1) + propylamine (2)					
0.0294	0.387	-0.0036	0.0154	0.0406	0.0149
0.0662	0.415	-0.0189	0.0229	0.0567	0.0217
0.0845	0.431	-0.0244	0.0283	0.0679	0.0268
0.1053	0.448	-0.0318	0.0329	0.0762	0.0310
0.1391	0.482	-0.0376	0.0459	0.1000	0.0434
0.1936	0.540	-0.0437	0.0678	0.1341	0.0643
0.2423	0.600	-0.0409	0.0930	0.1684	0.0686
0.2765	0.644	-0.0372	0.1110	0.1892	0.1061
0.3210	0.708	-0.0255	0.1393	0.2190	0.1335
0.3635	0.775	-0.0085	0.1699	0.2474	0.1635
0.3989	0.835	0.0099	0.1978	0.2703	0.1908
0.4418	0.909	0.0334	0.2306	0.2927	0.2231
0.4845	0.974	0.0482	0.2520	0.2994	0.2439
0.5165	1.031	0.0676	0.2745	0.3096	0.2661
0.5599	1.106	0.0916	0.3000	0.3165	0.2913
0.5942	1.166	0.1112	0.3187	0.3192	0.3097
0.6575	1.265	0.1358	0.3357	0.3083	0.3266
0.6877	1.309	0.1443	0.3378	0.2985	0.3288
0.7452	1.384	0.1516	0.3278	0.2703	0.3192
0.8042	1.442	0.1403	0.2908	0.2252	0.2832
0.8424	1.470	0.1233	0.2528	0.1887	0.2460
0.8852	1.495	0.0980	0.1993	0.1431	0.1939
0.9064	1.505	0.0831	0.1686	0.1188	0.1639
0.9584	1.522	0.0389	0.0802	0.0542	0.0779
0.9794	1.527	0.0192	0.0404	0.0268	0.0392
0.9258	1.470	0.0253	0.0952	0.0670	0.0914
0.9352	1.495	0.0392	0.1012	0.0701	0.0978
0.9398	1.505	0.0438	0.1019	0.0701	0.0986
0.9523	1.522	0.0461	0.0930	0.0631	0.0904
0.9556	1.527	0.0472	0.0911	0.0615	0.0886

Table 1.2: Deviation in viscosities for diethyleneglycol monomethyl ether with propylamine mixtures calculated from data given by Pal *et al*. (1-7) at 298.15K and atmospheric pressure

Δη/m Pas					
X	**ηmix**	**Δη1 from equation 1.1**	**Δη2 from equation 1.2**	**lnη3 from equation 1.3**	**Δη4 from equation 1.4**
diethyleneglycol monomethyl ether(1) + propylamine (2)					
0.0255	0.399	-0.0358	0.0218	0.561	0.0211
0.0563	0.444	-0.0861	0.0395	0.0931	0.0379
0.0879	0.493	-0.1348	0.0584	0.1260	0.0559
0.1249	0.562	-0.1802	0.0893	0.1730	0.0857
0.1605	0.634	-0.2183	0.1215	0.2127	0.1167
0.2036	0.735	-0.2505	0.1698	0.2626	0.1635
0.2453	0.842	-0.2725	0.2206	0.3039	0.2129
0.2996	1.010	-0.2724	0.3071	0.3625	0.2973
0.3405	1.159	-0.2498	0.3877	0.4072	0.3763
0.3854	1.334	-0.2137	0.4799	0.4459	0.4667
0.4144	1.455	-0.1823	0.5428	0.4669	0.5285
0.4488	1.601	-0.1427	0.6147	0.4844	0.5990
0.4769	1.726	-0.1046	0.6747	0.4958	0.6580
0.5252	1.953	-0.0269	0.7798	0.5097	0.7614
0.5736	2.163	0.0334	0.8536	0.5019	0.8336
0.6235	2.386	0.1021	0.9195	0.4867	0.8983
0.6581	2.523	0.1322	0.9366	0.4640	0.9148
0.7072	2.718	0.1753	0.9445	0.4269	0.9223
0.7563	2.892	0.1975	0.9093	0.3775	0.8875
0.7974	3.020	0.1984	0.8434	0.3275	0.8226
0.8476	1.165	0.1882	0.7256	0.2604	0.7072
0.8779	1.5	0.1545	0.6119	0.2104	0.5956
0.9088	1.297	0.1310	0.4939	0.1623	0.4806
0.9387	1.351	0.0925	0.3510	0.1107	0.3412
0.9526	1.375	0.0736	0.2788	0.0862	0.2709

Table 1.3: Deviation in viscosities for diethyleneglycol monoethyl ether with propylamine mixtures calculated from data given by Pal *et al*. (1-7) at 298.15K and atmospheric pressure

Δη/m Pas					
x	**ηmix**	**Δη1 from equation 1.1**	**Δη2 from equation 1.2**	**lnη3 from equation 1.3**	**Δη4 from equation 1.4**
diethyleneglycol monoethyl ether(1) + propylamine (2)					
0.0118	0.374	-0.0230	0.0079	0.0213	0.
0.0311	0.412	-0.0520	0.0287	0.0722	0.0280
0.0523	0.448	-0.0896	0.0449	0.1056	0.0438
0.0786	0.495	-0.1339	0.0659	0.1429	0.0641
0.0990	0.533	-0.1667	0.0826	0.1684	0.0803
0.1259	0.590	-0.2031	0.1099	0.2062	0.1069
0.1728	0.701	-0.2550	0.1643	0.2671	0.1600
0.2037	0.789	-0.2742	0.2115	0.3120	0.2062
0.2298	0.868	-0.2859	0.2535	0.3454	0.2475
0.2646	0.986	-0.2887	0.3186	0.3903	0.3114
0.3048	1.133	-0.2813	0.3987	0.4337	0.3902
0.3392	1.272	-0.2617	0.4752	0.4678	0.4655
0.4055	1.566	-0.1979	0.6333	0.5182	0.6213
0.4419	1.745	-0.1453	0.7281	0.5400	0.7148
0.4758	1.917	-0.0910	0.8148	0.5535	0.8004
0.5112	2.092	-0.0389	0.8932	0.5568	0.8775
0.5558	2.317	0.0313	0.9842	0.5530	0.9672
0.5903	2.488	0.0825	1.0414	0.5422	1.0234
0.6330	2.695	0.1412	1.0940	0.5207	1.0750
0.6711	2.869	0.1829	1.1163	0.4928	1.0968
0.7054	3.013	0.2079	1.1115	0.4603	1.0918
0.7412	1.154	0.2246	1.0838	0.4210	1.0641
0.7802	1.297	0.2321	1.0259	0.3727	1.0067
0.8328	1.464	0.2165	0.8906	0.2972	1.8732
0.8664	1.549	0.1849	0.7619	0.2416	1.7463
0.8935	1.616	0.1578	0.6436	0.1960	1.6300
0.9187	1.674	0.1283	0.5182	0.1520	1.5069
0.9388	1.712	0.0965	0.4019	0.1146	1.3928
0.9709	1.779	0.0520	0.2066	0.0562	1.2019

Table 1.4: Deviation in viscosities for diethyleneglycol monobutyl ether with propylamine mixtures calculated from data given by Pal *et al*. (1-7) at 298.15K and atmospheric pressure

Δη/m Pas						
X	ηmix	Δη1 from equation 1.1	Δη2 from equation 1.2		Ln η3 from equation 1.3	Δη4 from equation 1.4
diethyleneglycol monobutyl ether(1) + propylamine (2)						
0.0104	0.381	-0.0238	0.0150	0.0403	1.0411	0.0149
0.0212	0.404	-0.0516	0.0274	0.0702	1.0728	0.0271
0.0381	0.440	-0.0949	0.0461	0.1108	1.1171	0.0455
0.0898	0.562	-0.2157	0.1102	0.2184	1.440	0.1086
0.1063	0.602	-0.2532	0.1300	0.2434	1.2755	0.1281
0.1290	0.668	-0.2938	0.1667	0.2872	1.3327	0.1643
0.1640	0.780	-0.3461	0.2300	0.3493	1.4181	0.2267
0.1944	0.884	-0.3849	0.2878	0.3939	1.4827	0.2837
0.2231	1.003	-0.4007	0.3596	0.4440	1.5590	0.3548
0.2623	1.178	-0.4098	0.4641	0.5009	1.6501	0.4582
0.3079	1.400	-0.4019	0.5943	0.5526	1.7377	0.5870
0.3270	1.505	-0.3866	0.6575	0.5742	1.7757	0.6496
0.3856	1.851	-0.3158	0.8609	0.6257	1.8696	0.8511
0.4114	2.011	-0.2769	0.9508	0.6402	1.8968	0.9401
0.4443	2.230	-0.2124	1.0731	0.6563	1.9276	1.0613
0.4782	2.460	-0.1416	1.1943	0.6645	1.9435	1.1813
0.5424	2.900	-0.0031	1.3993	0.6588	1.9324	1.3842
0.5729	1.115	0.0687	1.4878	0.6494	1.9143	1.4717
0.6163	1.404	0.1539	1.5783	0.6230	1.8645	1.5610
0.6419	1.571	0.2006	1.6170	0.6030	1.8275	1.5991
0.6779	1.790	0.2506	1.6402	0.5670	1.7629	1.6216
0.7205	4.031	0.2915	1.6240	0.5156	1.6747	1.6050
0.7508	4.193	0.3112	1.5846	0.4747	1.6075	1.5655
0.7957	4.402	0.3094	1.4636	0.4042	1.4981	1.4452
0.8278	4.535	0.2917	1.3355	0.3488	1.4174	1.3179
0.8577	4.647	0.2632	1.1834	0.2939	1.3417	1.1672
0.8744	4.703	0.2408	1.0825	0.2616	1.2990	1.0673
0.9181	4.837	0.1696	0.7715	0.1738	1.	0.7600
0.9513	4.925	0.1017	0.4852	0.1037	1.1093	0.1775
0.9752	4.986	0.0505	0.2557	0.0526	1.0540	0.2514

Table 1.5: Deviation in viscosities for triethylene glycol monomethyl ether with propylamine mixtures calculated from data given by Pal *et al*. (1-7) at 298.15K and atmospheric pressure

Δη/m Pas					
x	ηmix	Δη1 from equation 1.1	Δη2 from equation 1.2	lnη3 from equation 1.3	Δη4 from equation 1.4
Triethylene glycol monomethyl ether(1) + propylamine (2)					
0.0053	0.369	-0.0182	0.0076	0.0207	0.0074
0.0087	0.378	-0.0293	0.0130	0.0350	0.0128
0.0251	0.415	-0.0890	0.0324	0.0814	0.0317
0.0368	0.440	-0.1330	0.0444	0.1064	0.0433
0.0680	0.514	-0.2429	0.0814	0.1724	0.0792
0.0810	0.549	-0.2846	0.1000	0.2010	0.0973
0.1050	0.617	-0.3581	0.1360	0.2490	0.1324
0.1254	0.682	-0.4134	0.1721	0.2907	0.1676
0.1752	0.861	-0.5280	0.2728	0.3811	0.2661
0.2146	1.034	-0.5873	0.3755	0.4513	0.3668
0.2627	1.279	-0.6259	0.5232	0.5261	0.5119
0.2934	1.456	-0.6299	0.6307	0.5677	0.6175
0.3347	1.724	-0.6054	0.7950	0.6183	0.7793
0.3651	1.935	-0.5736	0.9215	0.6467	1.9037
0.4217	2.362	-0.4803	1.1700	0.6839	1.1483
0.4710	2.749	-0.3840	1.3761	0.6943	1.3509
0.5445	1.350	-0.2164	1.6552	0.6814	1.6249
0.5740	1.599	-0.1413	1.7547	0.6686	1.7224
0.6281	4.032	-0.0273	1.8784	0.6271	1.8429
0.6683	4.359	0.0627	1.9425	0.5899	1.9050
0.7088	4.660	0.1249	1.9461	0.5406	1.9073
0.7716	5.104	0.1986	1.8549	0.4517	1.8159
0.8120	5.359	0.2154	1.7111	0.3846	1.6736
0.8595	5.626	0.2024	1.4462	0.2971	1.4126
0.8867	5.774	0.1900	1.553	0.2452	1.53
0.9185	5.920	0.1485	0.9702	0.1790	1.9459

Table 1.6: Deviation in viscosities for diethyleneglycol diethyl ether with propylamine mixtures calculated from data given by Pal *et al*. (1-7) at 298.15K and atmospheric pressure

Δη/m Pas					
x	ηmix	Δη1 from equation 1.1	Δη2 from equation 1.2	Ln η3 from equation 1.3	Δη4 from equation 1.4
diethyleneglycol diethyl ether(1) + propylamine (2)					
0.0050	0.361	0.0004	0.0027	0.0076	0.0027
0.0106	0.367	0.0013	0.0062	0.0170	0.0061
0.0197	0.379	0.0050	0.0140	0.0376	0.0138
0.0413	0.402	0.0083	0.0268	0.0691	0.0264
0.0623	0.423	0.0102	0.0377	0.0933	0.0370
0.0897	0.451	0.0132	0.0520	0.1226	0.0511
0.1329	0.498	0.0208	0.0765	0.1669	0.0751
0.1762	0.538	0.0213	0.0927	0.1891	0.0908
0.2138	0.572	0.0210	0.1049	0.2026	0.1026
0.2434	0.600	0.0220	0.1150	0.2128	0.1124
0.2446	0.603	0.0239	0.1173	0.2163	0.1146
0.2849	0.636	0.0202	0.1248	0.2184	0.1217
0.2887	0.640	0.0207	0.1263	0.2198	0.1232
0.3251	0.672	0.0195	0.1340	0.2224	0.1305
0.3686	0.709	0.0168	0.1404	0.2207	0.1266
0.4053	0.737	0.0114	0.1413	0.2128	0.1412
0.4615	0.786	0.0091	0.1462	0.2058	0.1417
0.5261	0.848	0.0122	0.1535	0.1997	0.1486
0.5564	0.875	0.0116	0.1532	0.1925	0.1482
0.6025	0.919	0.0135	0.1537	0.1830	0.1486
0.6358	0.951	0.0152	0.1526	0.1749	0.1475
0.6749	0.988	0.0165	0.1490	0.1634	0.1439
0.7261	1.038	0.0198	0.1426	0.1478	0.1377
0.7852	1.090	0.0179	0.1248	0.1216	0.1204
0.8437	1.152	0.0265	0.1123	0.1026	0.1087
0.8917	1.201	0.0318	0.0960	0.0833	0.0931
0.9396	1.35	0.0221	0.0606	0.0504	0.0589
0.9698	1.48	0.0075	0.0277	0.0225	0.0268

Table 1.7: Deviation in viscosities for diethyleneglycol dibutyl ether with propylamine mixtures calculated from data given by Pal *et al*. (1-7) at 298.15K and atmospheric pressure

Δη/m Pas					
X	ηmix	Δη1 from equation 1.1	Δη2 from equation 1.2	lnη3 from equation 1.3	Δη4 from equation 1.4
diethyleneglycol dibutyl ether(1) + propylamine (2)					
0.0095	0.375	0.0019	0.0128	0.0349	0.0128
0.0288	0.417	0.0090	0.0420	0.1062	0.0418
0.0455	0.450	0.0119	0.0636	0.1523	0.0632
0.0845	0.529	0.0206	0.1144	0.2437	0.1137
0.1266	0.622	0.0376	0.1747	0.3298	0.1736
0.1754	0.719	0.0466	0.2306	0.3867	0.2290
0.2172	0.806	0.0582	0.2794	0.4256	0.2773
0.2531	0.870	0.0574	0.3081	0.4372	0.3057
0.2660	0.904	0.0681	0.3289	0.4523	0.3264
0.3172	0.994	0.0658	0.3633	0.4549	0.3602
0.3559	1.055	0.0570	0.3787	0.4447	0.3752
0.3977	1.129	0.0555	0.3998	0.4371	0.3959
0.4621	1.40	0.0504	0.4210	0.4148	0.4165
0.5160	1.330	0.0431	0.4274	0.3877	0.4225
0.5979	1.489	0.0544	0.4428	0.3530	0.4374
0.6482	1.579	0.0536	0.4335	0.3210	0.4279
0.6986	1.689	0.0727	0.4345	0.2974	0.4289
0.7471	1.774	0.0702	0.4049	0.2591	0.3994
0.7956	1.869	0.0777	0.3748	0.2238	0.3697
0.8618	2.010	0.0993	0.3264	0.1772	0.3222
0.9261	2.093	0.0663	0.2024	0.1017	0.1998
0.9641	2.143	0.0478	0.1184	0.0568	0.1169

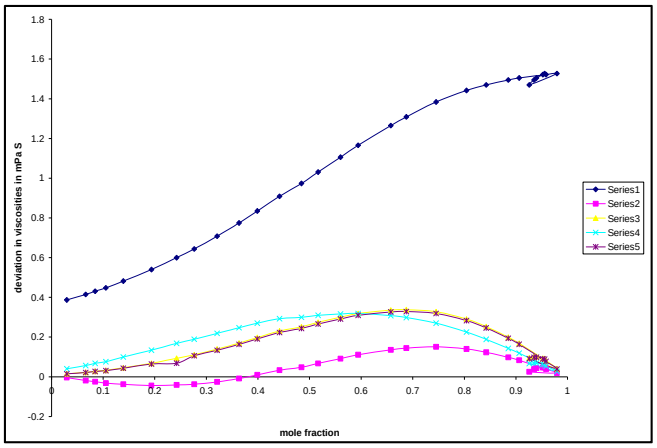

Fig: 1.1: Deviation in viscosities for ethyleneglycol monomethyl ether with propylamine mixtures at 298.15K and atmospheric pressure. Series 1 for ηmix, Series 2 for Δη1, Series 3 for Δη2, Series 4 for ln η3, Series 5 for Δη4.

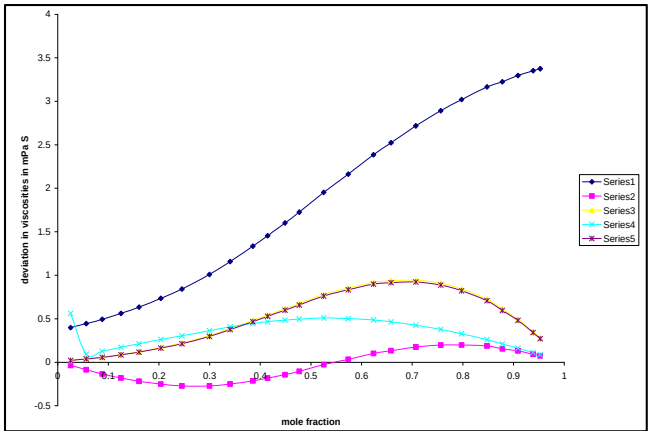

Fig 1.2: Deviation in viscosities for diethyleneglycol monomethyl ether with propylamine mixtures at 298.15K and atmospheric pressure. Series 1 for ηmix, Series 2 for Δη1, Series 3 for Δη2, Series 4 for ln η3, Series 5 for Δη4.

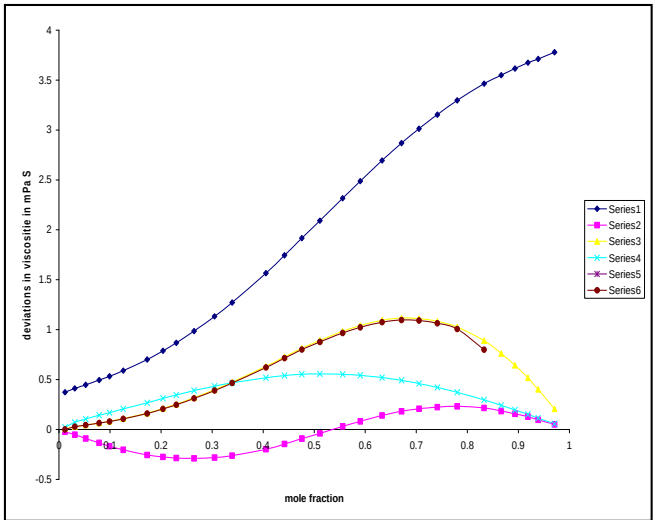

Fig 1.3: Deviation in viscosities for diethyleneglycol monoethyl ether with propylamine mixtures at 298.15K and atmospheric pressure. Series 1 for ηmix, Series 2 for Δη1, Series 3 for Δη2, Series 4 for ln η3, Series 5 for Δη4.

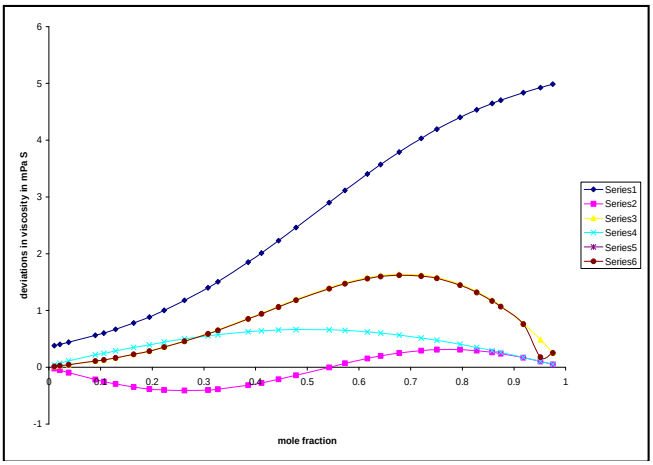

Fig 1.4: Deviation in viscosities for diethyleneglycol monobutyl ether with propylamine mixtures at 298.15K and atmospheric pressure. Series 1 for ηmix, Series 2 for Δη1, Series 3 for Δη2, Series 4 for ln η3, Series 5 for Δη4.

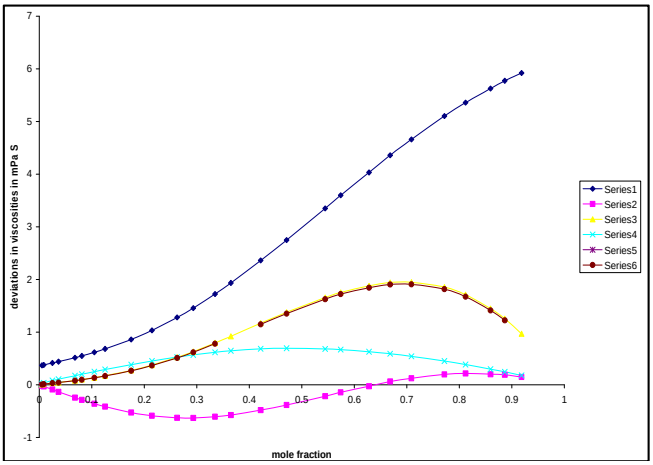

Fig 1.5: Deviation in viscosities for triethyleneglycol monomethyl ether with propylamine mixtures at 298.15K and atmospheric pressure. Series 1 for ηmix, Series 2 for Δη1, Series 3 for Δη2, Series 4 for ln η3, Series 5 for Δη4.

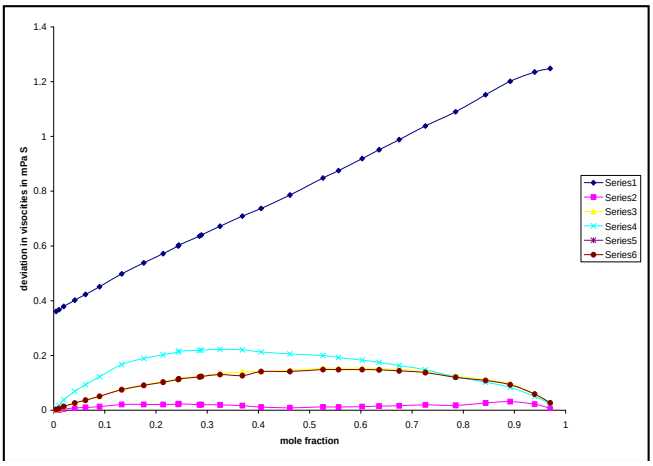

Fig 1.6: Deviation in viscosities for diethyleneglycol diethyl ether with propylamine mixtures at 298.15K and atmospheric pressure. Series 1 for ηmix, Series 2 for Δη1, Series 3 for Δη2, Series 4 for ln η3, Series 5 for Δη4.

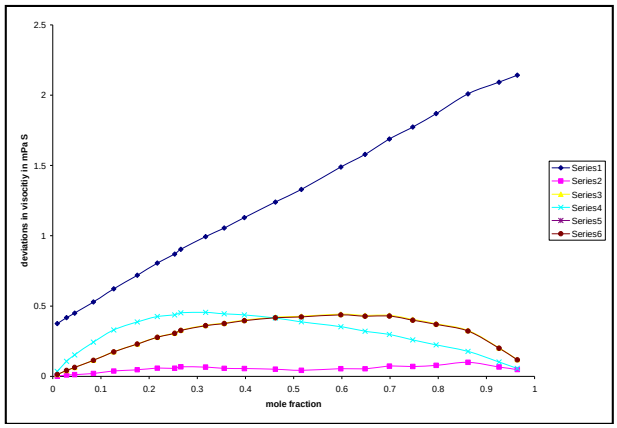

Fig 1.7: Deviation in viscosities for diethyleneglycol dibutyl ether with propylamine mixtures at 298.15K and atmospheric pressure. Series 1 for ηmix, Series 2 for Δη1, Series 3 for Δη2, Series 4 for ln η3, Series 5 for Δη4.

Conclusion

An examination has been made of some of graphical and analytic perspective of the thermodynamic data that have been accumulated for the non-aqueous mixtures. In conclusion, it is fair to ask whether we are any closer to an understanding of the nature of the patterns of molecular aggregation which exist within such mixtures. Our studies indicate that we are still in the dark regarding the proper elucidation of different types of interactions that occur in solution.

However, from the study it is clear that different physicochemical properties like viscosity and speed of sound are necessary to have some clear understanding regarding the composition dependence behavior of alkoxyalkanols [8-16] (Amphiphile).

Thermodynamic studies do not directly address questions related to molecular scale features. It may furnish striking features of composition dependence that might reasonable be associated with important changes in the patterns of molecular aggregation.

The question may legitimately be posed to whether any of simpler amphiphile + an organic system also furnish evidence of more than the one significant variation in their patterns of aggregation. Such evidence would have to be derived directly from data in some appropriate graphical format which satisfy some type of statistical test of a conceptual model.

Determination of excess viscosities. For intensive properties like viscosity, the deviations from ideality should be referred to as such rather than excess quantities. Although, the term excess viscosity has been used in literature [8-16]. Its use is not acceptable. The usual procedure to have the excess viscosities is

$$\eta^E = \eta - x_1\eta_1 - x_2\eta_2 \qquad (1.1)$$

But the exact calculation of excess viscosities are more or less elusive. Most of worker, [8-16]. However, prefer to use the term "derivation in viscosity" by using equation 4.1. But the effect of different methods of calculation of viscosity deviations are different and comparison of the results are also difficult unless the clear definition on ideal viscosities are available. Although, our study reports the deviation in viscosity using equation (from introduction) very information knowledge are obtained in predicting the kind of interactions that are causing strong deviations from ideality in equation state and it has been systematically investigated along with the other properties, in the study of liquid mixtures. The needs to be an expression where ideal solution behavior of viscosity property has been well defined. Questions concerning the patterns of aggregation in binary non-aqueous mixtures will not be properly answered until such time as: becomes feasible to carry out large scale computer simulations. That is not something that is anticipated in the immediate future. It is possible, however, to examine the stabilities and preferred structures of small cluster using molecular modeling techniques.

Our studies reveal the fact that C_mE_n species are capable of existing in wide variety of different conformations, many of which are close enough in energy to the most stable of their number that they have significant populations. The sequence of conformational energies in gas phase is likely to differ from those in the pure states and those existing in non-aqueous mixtures. Significant changes in conformation on going from the pure liquid to a non-aqueous mixture may well have a significant effect on the values of excess molar properties.

This dissertation has dealt with non-aqueous binary mixtures of alkoxyalkanols as one of the components. These types of compounds become the object of a great many investigation because of the possibility of different types of molecular structural modification. In that sense, it is believed that the lessons from the study of mixtures of the members of C_mE_n family serve to enhance our understanding of alkoxyalkanol + anorganic solvent mixtures in general. We may be able to discuss the structures of these mixtures somewhat more intelligently than before but we obviously still have a long way to go before our understanding of them will have reached a completely satisfactory level.

References

1. Pal A, Singh W. Fluid Phase Equilib, 1997; 129:211.
2. Pal A, Kumar A. Fluid Phase Equilib, 1998; 143:241.
3. Pal A, Kumar A. Indian J Chem. 1999; 38A:275.
4. Pal A, Dass G, Shama S. Proc. Indian Acad. (Chem, Sci.), 1999; 111:659.
5. Pal A, Kumar H, International J Thermophysics. 2006, 1.
6. Pal A, Aharma SS, Kumar H. Can. J Chem. 2000; 78:427.
7. Pal A, Bhardwaj RK, Can. J Chem. 2002; 80:467.
8. Acree WE. (Jr.) Thermodynamic Properties of Non electrolyte Solutions, Academic Press: New York, 1984.
9. Prausnitz JM, Lichtenthaler RN, Azevedo EG. Molecular Thermodynamics of Fluid Phase Equilibria, 2nd Edn. Prentice Hall Inc. Englewood Cliffs: N. J. 1986.
10. Rowlinson JS, Swinton FL. Liquids and Liquid Mixtures, 3rd Edn. Butterworth Scientific: London. 1982.
11. Douhéret G, Davis MI. Chem. Soc. Rev1993; 22:43.
12. Liler, Kosanovic. Hydrogen bonding, edited by Hadz i, Pergamon Press: London, 1959, 529.
13. Thomas LH, Davies GHJ. Chem. Soc1969**,** 1271.
14. Glasstone S, Laidler KJ, Eyring H. The Theory of Rate Processes, McGraw Hill: New York. 1941.
15. Fort RJ, Moore WR. Trans. Faraday Soc1966; 62:112.
16. Dymond JH. Chem. Soc. Rev. 1985; 14:317.