"Interpretation of Molecular Interaction between Binary Mixture of Triethyl Silicol and Butanol based on the Acoustic and Thermodynamic properties"

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Abstract: -This Research Paper deals with the "The Acoustic Binary Mixtures of organic Silicon Compounds with Butanol" in which with the help of experimental values of Ultrasound velocity, density and Viscosity other acoustic and Thermodynamic properties like Isentropic Compressibility (βs), Specific Acoustic Impedance (C.G.S.), Molar and available Volume,Intermolecular free length (L_f) , Ultrasound velocity (V) , Density (ρ) , Excess Viscosity (η) , Shear's Relaxation Time (τ_s) have been computed at different temperature(30,40°C). In each case negative values of β_s^E, V_m^E, V_a^E and positive value of η^E indicates the strong interaction between the components of the mixtures. While positive values of β_s^E, V_m^E, V_a^E and negative value of η^E decide the weak interaction between the liquid molecules due to dispersion forces. The ultrasound velocity and density increase on increasing mole fraction of triethyl silicol, but both decreases on increasing temperature. Other parameters like Specific Acoustic Impedance, Shear Relaxation Time (τ_s) and Rao's Constant(R) support the specific interaction between the molecules. With observations of negative excess of Isentropic Compressibility and positive viscosity.The Result has been interpreted in terms of plots and graphs.

***Key Words*:** - Molecular Interaction, Interferometric Technique, Triethyl Silicol, Butanol, Ultrasonic Velocity, Viscosity&Density,Acoustic, Thermodynamic

INTRODUCTION

The Molecular interaction is fundamental property of the molecules regarding structural arrangement of the atoms, ions and groups. Molecular interaction occurs due to different type of forces between the molecule of electrolytes in solvent i.e., Ion-Solvent interaction, solvent-solvent interaction and mix interaction between solid, liquid and gas. Molecular interactions depend on the unlike forces like dipole-dipole interaction, dipole induced interaction and dispersion forces weak bonding like hydrogen bonding, vander waal's bond also affect the molecular interaction. SiliconMetal compound are known as insulator because of its insulating properties, these non-conducting properties influence us for the study of acoustic and Thermodynamic property of silicon derivatives in liquid state with other organic compound. The organic derivative of silicon behaves as polar organic compound due to the presence of polarizing group behave as activating the group of silicon organo metallic compound, which are miscible in the alcohol. These silicon organo metallic compound form coordinated compound with alcoholic molecules. These alkyl derivatives of silicon alcohols with alkanols form a no. of complex derivatives which act as polar complex compounds whose acoustic &Thermodynamic properties can be explained in terms of molecular interaction. In this paper "The Acoustic and Thermodynamic studies of Binary Mixture of organic silicon Compounds with Butanol" have been reported

RESULT AND DISCUSSION

Ultrasound velocity is one of the technique beyond all experimental techniques to determine the molecular interaction hence in this present work molecular interaction of triethyl silicoland butanol is carried out by Interferometric technique which is used to measure ultrasound velocity in liquids and on the basis of experimental values of Ultrasound velocity, density and viscosity other Thermodynamic properties like isentropic compressibility (β_s) , intermolecular free length (L_f) , molar volume (M_v) , Shear's Relaxation Time (τ_s), Specific Acoustic Impedance, Rao's Constant(R) have been calculated.

Interaction between Triethyl silicol and Butanol is carried out at various temp. (30°C,40°C) with various parameter.

Interferometer Procedure technique is advantageous due to itsavailability of measuring the ultrasonic velocity over the wide range of temperature i.e., -30 to +80C. Viscosity of solvent is measured by suspended level canon-ubbelhode type viscometer and a double walled pyknometer is used for the measurement of the density of the solvent and solutions. The experiment was repeated and covers the observation of binary mixture of silicon within alcoholic solvent. Experiment was carried out at different temperature(30,40°C).
The properties which may be regarded as good criteria for the interpretation of molecular interaction and directly related to ultrasound velocity are density, isentropic compressibility, intermolecular free length, molar volume, available volume and free volume. we have reported ultrasound velocity (V) and Viscosity (η) of binary liquid mixture with experimental data, the following thermodynamic and acoustic properties like Isentropic compressibility (β_s), intermolecular free length (L_f), Molar Volume (M_v), Shear's Relaxation Time (τ_s) have been calculated and reported in Table 1-6 as well as on Fig.1-4

To compute the molecular interaction between the unlike molecules, the computed excess values of the acoustic and Thermodynamic parameters focus on the nature and extent of interaction. The negative values of β_s^E, V_m^E, V_a^E and positive value of η^E indicates the strong interaction between the components of the mixtures. While positive values of β_s^E, V_m^E, V_a^E and negative value of η^E decide the weak interaction between the liquid molecules due to dispersion forces. The ultrasound velocity and density increase on increasing mole fraction of triethyl silicol, but both decreases on increasing temperature. The trend of variation of excess molar volume is positive at 30°C but it is negative at 40°C which clearly show the increasing molecular interaction on increasing temperature. The extent of interaction in triethyl silicol+ Butanol is quite low and peak of figures are obtained at mole fraction 0.3161 and 0.5189 at 30°C &40°C respectively.

Table 1: Triethyl Silicol+Butanol at 30°C

Mole Fraction of Triethyl Silicol	Density (exp.)	Density (add.)	Density (excess)	*Ultrasound Velocity*	β_s (Exp) cm^2/dyne.10^{12}	β_s (add) cm^2/dyne.10^{12}	β_s (excess) cm^2/dyne.10^{12}
0.000	0.8024	0.8024	0.0000	1290	74.89	74.89	0.00
0.0401	0.8085	0.8096	-0.0011	1300	73.19	73.99	-0.81
0.0859	0.8160	0.8179	-0.0019	1310	71.41	72.97	-1.55
0.1388	0.8242	0.8274	-0.0032	1320	69.63	71.79	-2.15
0.2005	0.8341	0.8385	-0.0044	1328	67.98	70.41	-2.43
0.2733	0.8465	0.8516	-0.0051	1336	66.24	68.78	-2.54
0.3607	0.8631	0.8673	-0.0042	1343	64.23	66.83	-2.60
0.4674	0.8832	0.8865	-0.0033	1355	61.67	64.44	-2.77
0.6007	0.9084	0.9105	-0.0021	1366	58.99	61.46	-2.46
0.7719	0.9404	0.9413	-0.0009	1379	55.93	57.63	-1.70
1.0000	0.9824	0.9824	0.0000	1392	52.53	52.53	0.00

Table 2: Triethyl Silicol+ Butanol at 30°C

Mole Fractionof Triethyl Silicol	Intermolecular Free Length(exp) A°	Intermolecular Free Length(add) A°	Intermolecular Free Length(excess) A°	*Molar Volume* (exp) ml/mole	*Molar Volume* (add) ml/mole	*Molar Volume* (excess) ml/mole	*Specific Acoustic Impedance* (C.G.S)
0.000	0.5461	0.5461	0.0000	92.39	92.39	0.00	1.0351
0.0401	0.5398	0.5425	-0.0027	95.46	94.82	0.64	1.0511
0.0859	0.5332	0.5385	-0.0052	98.86	97.59	1.27	1.0689
0.1388	0.5266	0.5338	-0.0072	102.75	100.78	1.97	1.0879
0.2005	0.5203	0.5283	-0.0080	107.15	104.51	2.64	1.1077
0.2733	0.5135	0.5218	-0.0083	112.12	108.92	3.21	1.1305
0.3607	0.5057	0.5141	-0.0084	117.66	114.20	3.46	1.1593
0.4674	0.4955	0.5046	-0.0091	124.17	120.65	3.52	1.1968
0.6007	0.4847	0.4928	-0.0081	131.88	128.71	3.17	1.2409
0.7719	0.4719	0.4776	-0.0056	141.24	139.07	2.17	1.2967
1.0000	0.4573	0.4573	0.0000	152.86	152.86	0.00	1.3675

Table 3: Triethyl Silicol+ Butanol at 30°C

Mole Fraction of Triethyl Silicol	Available Volume (exp)	Available Volume (add)	Available Volume (excess)	*viscocity* (exp) C.P.	*viscocity* (add) C.P.	*viscocity* (excess) C.P.	*Shear's Relaxation Time* (τ_s)	Rao's Constant
0.000	17.90	17.90	0.00	2.8513	2.8513	0.0000	284.7156	1005.75
0.0401	17.90	17.98	-0.08	2.7725	2.7626	0.0099	270.5376	1034.81
0.0859	17.92	18.07	-0.15	2.6814	2.6612	0.0202	255.3179	1067.78
0.1388	17.98	18.17	-0.19	2.5680	2.5442	0.0238	238.4336	1105.56
0.2005	18.22	18.29	-0.08	2.4350	2.4078	0.0272	220.7192	1148.77
0.2733	18.54	18.44	0.10	2.2765	2.2467	0.0298	201.0471	1199.43
0.3607	18.89	18.61	0.28	2.0794	2.0535	0.0259	178.0654	1259.99
0.4674	19.01	18.82	0.19	1.8394	1.8174	0.0220	151.2369	1335.12
0.6007	19.29	19.08	0.20	1.5402	1.5225	0.0177	121.1498	1428.16
0.7719	19.53	19.42	0.11	1.1525	1.1437	0.0088	85.9481	1547.86
1.0000	19.87	19.87	0.00	0.6392	0.6392	0.0000	44.7722	1706.76

Table 4: Triethyl Silicol+ Butanol at 40°C

Mole Fraction of Triethyl Silicol	Density (exp.)	Density (add.)	Density (excess)	*Ultrasound Velocity*	β_s (Exp) cm^2/dyne.10^{12}	β_s (add) cm^2/dyne.10^{12}	β_s (excess) cm^2/dyne.10^{12}
0.000	0.7048	0.7048	0.0000	1270	87.97	87.97	0.00
0.0401	0.7122	0.7140	-0.0018	1286	84.92	86.72	-1.80

0.0859	0.7218	0.7246	-0.0028	1300	81.98	85.29	-3.31
0.1388	0.7325	0.7367	-0.0042	1310	79.50	83.65	-4.15
0.2005	0.7455	0.7509	-0.0054	1319	77.11	81.73	-4.62
0.2733	0.7618	0.7677	-0.0059	1330	74.22	79.46	-5.24
0.3607	0.7825	0.7878	-0.0053	1336	71.60	76.74	-5.14
0.4674	0.8082	0.8123	-0.0041	1340	68.91	73.42	-4.51
0.6007	0.8400	0.8430	-0.0030	1352	65.13	69.26	-4.13
0.7719	0.8804	0.8823	-0.0019	1366	60.87	63.93	-3.06
1.0000	0.9348	0.9348	0.0000	1372	56.83	56.83	0.00

Table 5: Triethyl Silicol+ Butanol at 40°C

Mole Fraction of Triethyl Silicol	**Intermolecular Free Length(exp) A°**	**Intermolecular Free Length(add) A°**	**Intermolecular Free Length(excess) A°**	***Molar Volume* (exp) ml/mole**	***Molar Volume* (add) ml/mole**	***Molar Volume* (excess) ml/mole**	***Specific Acoustic Impedance* (C.G.S)**
0.000	0.6021	0.6021	0.0000	105.18	105.18	0.00	0.8951
0.0401	0.5916	0.5974	-0.0057	108.36	107.40	-0.07	0.9158
0.0859	0.5813	0.5920	-0.0107	111.76	109.95	-0.11	0.9383
0.1388	0.5724	0.5857	-0.0133	115.61	112.88	-0.15	0.9599
0.2005	0.5638	0.5784	-0.0147	119.88	116.30	-0.20	0.9832
0.2733	0.5531	0.5698	-0.0167	124.60	120.34	-0.22	1.0131
0.3607	0.5432	0.5595	-0.0163	129.79	125.18	-0.20	1.0454
0.4674	0.5329	0.5469	-0.0140	135.70	131.10	-0.13	1.0830
0.6007	0.5181	0.5312	-0.0130	142.63	138.49	-0.10	1.1356
0.7719	0.5009	0.5109	-0.0101	150.86	147.99	-0.05	1.2027
1.0000	0.4840	0.4840	0.0000	160.64	160.64	0.00	1.2825

Table 6: Triethyl Silicol+Butanol at 40°C

Mole Fraction of Triethyl Silicol	**Available Volume (exp)**	**Available Volume (add)**	**Available Volume (excess)**	***viscocity* (exp) C.P.**	***viscocity* (add) C.P.**	***viscocity* (excess) C.P.**	***Shear's Relaxation Time*** (τ_s)	**Rao's Constant (R)**
0.000	21.69	21.69	0.00	2.6522	2.6522	0.0000	311.0797	1139.03
0.0401	21.28	21.74	-0.46	2.5670	2.5670	0.0147	292.3319	1167.92
0.0859	20.96	21.79	-0.84	2.4952	2.4696	0.0256	272.7479	1199.95
0.1388	20.92	21.86	-0.93	2.3861	2.3573	0.0288	252.9261	1235.22
0.2005	21.06	21.93	-0.87	2.2588	2.2263	0.0325	232.2408	1275.39
0.2733	21.03	22.02	-0.98	2.1065	2.0715	0.0350	208.4735	1323.35

0.3607	21.42	22.12	-0.71	1.9172	1.8859	0.0313	183.0365	1378.73
0.4674	22.05	22.25	-0.20	1.6859	1.6592	0.0267	154.8946	1445.36
0.6007	22.11	22.41	-0.30	1.3978	1.3760	0.0218	121.3827	1531.41
0.7719	22.06	22.62	-0.55	1.0262	1.0121	0.0141	83.2874	1642.06
1.0000	22.89	22.89	0.00	0.5276	05276	0.0000	39.9776	1785.00

System: Triethyl Silicol + Butanol

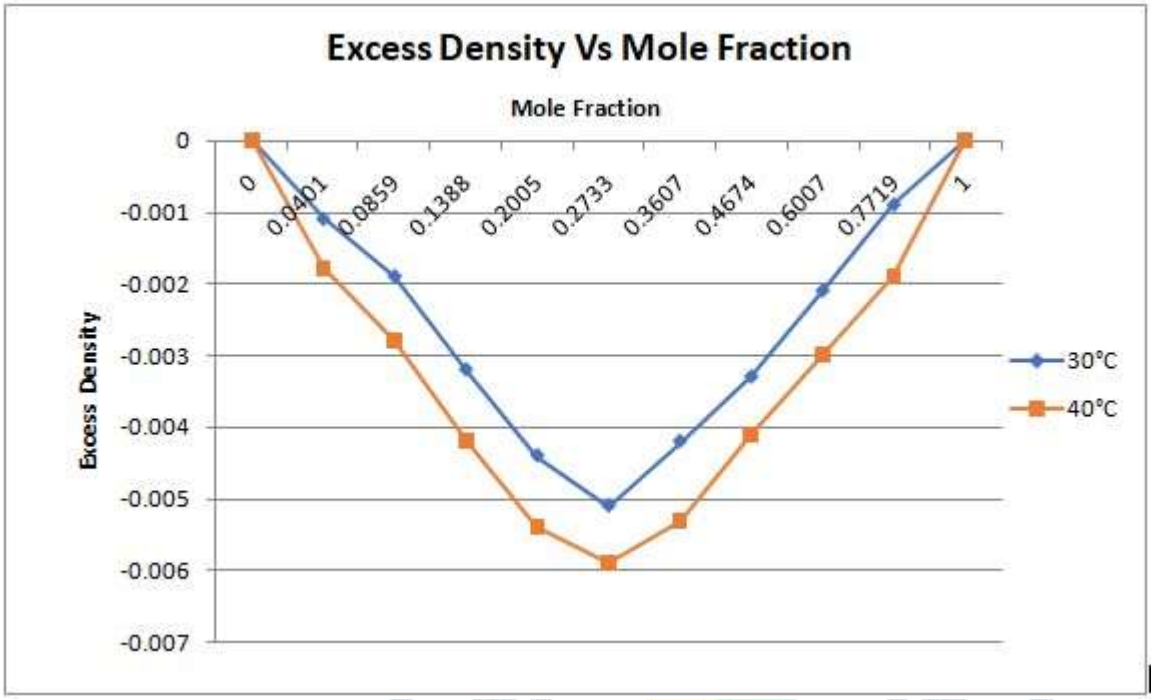

Figure-1

System: Triethyl Silicol + Butanol

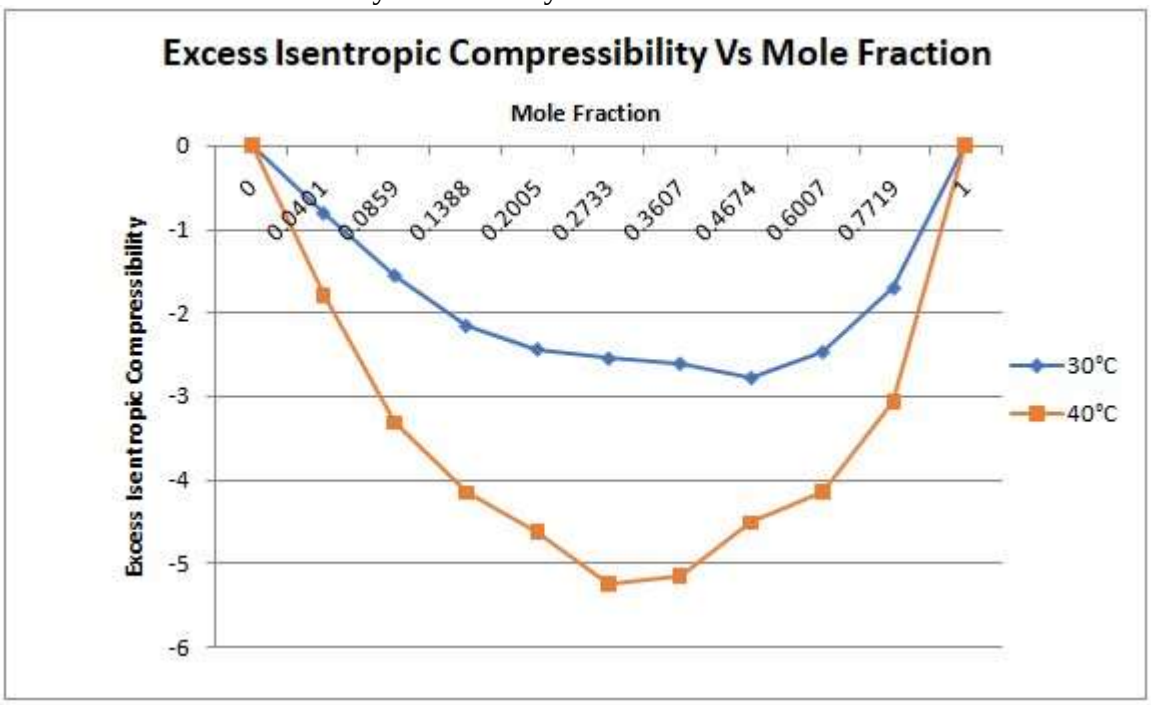

Figure-2

System: Triethyl Silicol + Butanol

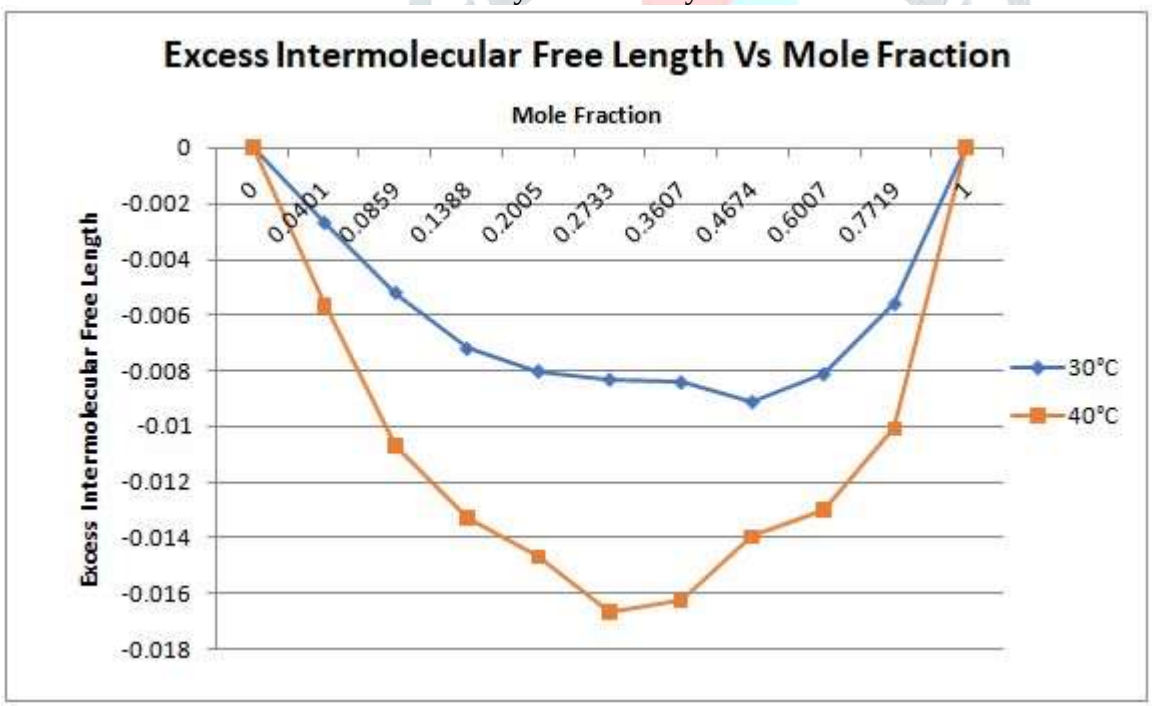

Figure-3

System: Triethyl Silicol + Butanol

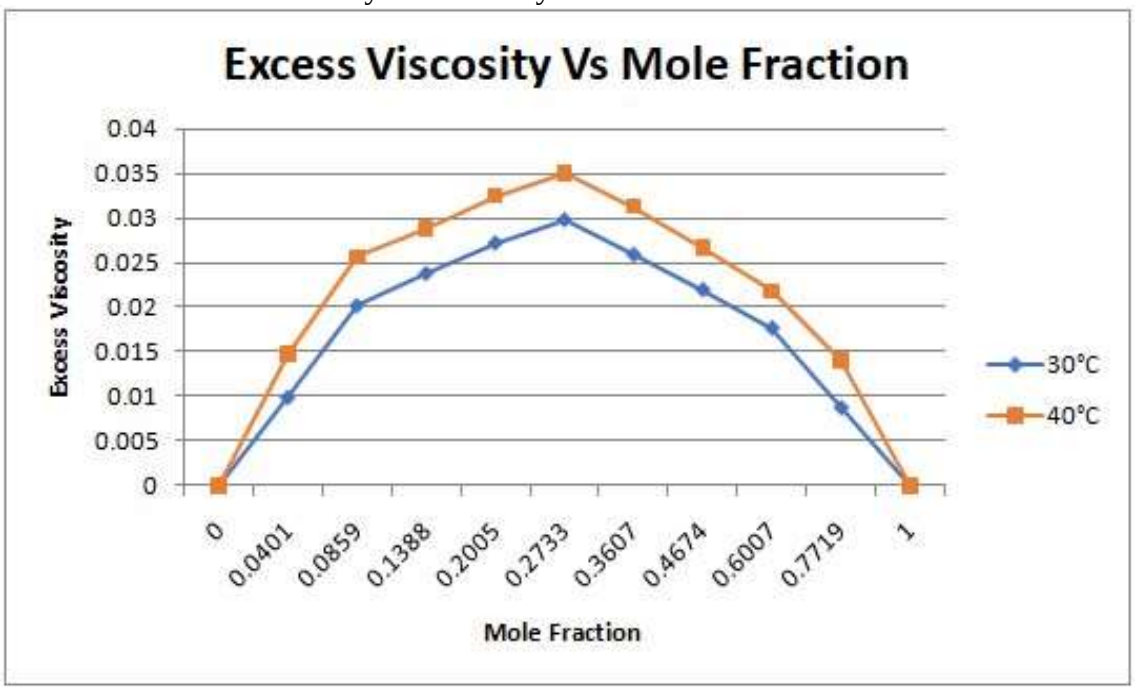

Figure-4

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