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Research Article

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Effect of temperature on the molecular dynamics of some binary mixtures by ultrasonic method

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ABSTRACT

Ultrasonic velocities (U), densities (ρ), and coefficient of viscosities (η) are measured for binary mixtures containing (i) cholorobenzene - 1 – propanol and (ii) cholorobenzene – benzylalcohol at 303K, 308K, and 313K to under stand the molecular interaction. Various acoustical parameters such as adiabatic compressibility (β) , free length (L_f), acoustic impedance (Z), relaxation time (τ), free volume (V_f), available volume (V_a), and internal pressure (π_i), are calculated from the measured values of U, ρ, and η. The trend in acoustical parameters also substantiates to asses weak and strong molecular interacations. Other interesting features were observed and they are discussed.

Key words: Ultrasonic velocities, Binary mixture, Free volume and Internal pressure.

INTRODUCTION

Ultra sonic studies provide a wealth of information about the state of the liquid. Ultra sonic velocity measurement has been adequately employed to understand the nature of the molecular interactions in binary mixtures [1,2] and ionic interactions in aqueous electrolytic solutions[3].Measurement of ultrasonic velocity and other acoustical properties can be related to physico-chemical behaviors and molecular interactions in a number of binary systems. Sehal and Porter studied the non-linear parameter for alcohol and water mixtures and based on this parameter discussed the inter molecular interactions [4]. Anwar ali and co-workers carried out investigations on the interactions of ion-solvent system by ultrasonic method [5]. In this paper, ultra sonic studies were carried out in the following binary mixtures

(i) Chlorobenzene -1 – propanol and (ii) chlorobenzene-benzylalcohol at 303K, 308K and 313K. The acoustical parameters have been calculated for these two binary mixtures at different concentration of chlorobenzene.

EXPERIMENTAL SECTION

1-Propanol and benzyl alcohol are (AR grade) used as such. The spectral grade Chloro benzene of BDH make was used after simple distillation. The various binary mixtures are prepared by using Jobs continuous variation method [6-10]. The ultra sonic velocity (U) have been measured is ultra sonic inter ferometer (Model F81) supplied by Mittal Enterprises, New Delhi operating at a frequency of 2 MHz with an accuracy of ±0.1%. The viscosities (η) of pure compounds and their binary mixtures were determined using Ostwald's viscometer by calibrating with double distilled water. The densities (ρ) of pure compounds and their solutions were measured accurately using 10ml specific gravity bottle in an electronic balance precisely and the accuracy in weighing is ±0.1 mg. The temperature of the pure solutions and the binary mixtures were maintained at 303, 308 and 313 K with ± 0.1 K accuracy using a thermostat. The acoustical parameters are calculated from U, ρ and η values [11-15] using the following relations.

1. ADIABATIC COMPRESSIBILITY (β)

The adiabatic compressibility values for various compositions of the binary liquid mixtures have been calculated from the measured ultrasonic velocities and densities.

$$\beta = \frac{1}{U^2 \rho}$$

2. FREE LENGTH (L_f)

The free length in a liquid mixture is related to ultrasonic velocity and density as,

$$L_f = \frac{K}{\sqrt{\rho U}}$$

Where, $K = 2 \times 10^{-6}$

3. ACOUSTIC IMPEDANCE (Z)

The specific acoustic impedance is related to density and ultrasonic velocity by the relation.

$$Z = U\rho$$

4. RELAXATION TIME (τ)

Relaxation time can be calculated from viscosity coefficient density and ultrasonic velocity of binary liquid mixtures and is given by,

$$\tau = \frac{4\eta}{3\rho U^2}$$

5. FREE VOLUME (V_f)

The free volume of binary liquid mixture is given by

$$V_f = [M_{eff} U / K \eta]^{3/2}$$

Where, $K = 4.28 \times 10^9$

M_{eff} = Effective molecular weight.

Effective molecular weight of liquid binary mixture is given by

$$M_{eff} = X_1 M_1 + X_2 M_2$$

Where X_1 & X_2 are the mole fractions of the first and second components and M_1 & M_2 are the molecular weights of first and second components respectively.

6. AVAILABLE VOLUME (V_a)

Another parameter which can be calculated from ultrasonic velocity is the available volume and is given by,

$$V_a = V [1 - U/U_\infty]$$

Where, U_∞ = Schaaf's limiting value taken as 1600 m/s for liquids.

7. INTERNAL PRESSURE (π_i)

Internal pressure is given by,

$$\pi_i = \frac{bRT(K\eta)^{1/2}}{(U)^{1/2}} x \frac{(\rho)^{2/3}}{(M_{eff})^{7/6}}$$

Where,

b = the cubic packing factor which is assumed to be two
Or (solution) liquid state.

K = the temperature independent constant 4.28×10^9

RESULTS AND DISCUSSION

Ultrasonic Velocity (U)

The measured ultrasonic velocity, with increase in mole fraction of chlorobenzene with 1-propanol and benzyl alcohol at three different temperatures are given in Tables 1-6

Table 1 Ultrasonic Velocity (U), density (ρ), and viscosity (η) values for the binary mixture of chlorobenzene-1-propanol at 303 K

Mole fraction of Chlorobenzene	Ultrasonic Velocity U (ms^{-1})	Density ρ ($Kg\ m^{-3}$)	Viscosity η x 10^{-3} (Nm^{-2} s)
0.00	1187.2	794.4	1.611
0.08	1195.2	824.3	1.417
0.16	1198.4	856.2	1.277
0.24	1203.2	886.6	1.187
0.33	1207.2	915.2	1.077
0.42	1210.0	946.9	0.988
0.52	1220.8	975.9	0.922
0.63	1238.8	1004.8	0.849
0.75	1246.4	1033.7	0.822
0.87	1248.0	1065.5	0.808
1.00	1258.4	1095.3	0.803

Table 2 Ultrasonic Velocity (U), density (ρ), and viscosity (η) values for the binary mixture of chlorobenzene-1-propanol at 308 K

Mole fraction of Chlorobenzene	Ultrasonic Velocity U (ms^{-1})	Density ρ ($Kg\ m^{-3}$)	Viscosity η x 10^{-3} (Nm^{-2} s)
0.00	1178.4	793.1	1.563
0.08	1182.4	822.1	1.377
0.16	1185.6	854.4	1.225
0.24	1190.0	883.7	1.105
0.33	1193.2	912.5	1.015
0.42	1197.2	943.7	9.231
0.52	1202.0	975.4	8.606
0.63	1205.2	1002.4	8.212
0.75	1215.2	958.8	7.249
0.87	1217.6	1061.6	7.556
1.00	1235.6	1092.6	7.735

Table 3 Ultrasonic Velocity (U), density (ρ), and viscosity (η) values for the binary mixture of chlorobenzene-1-propanol at 313 K

Mole fraction of Chlorobenzene	Ultrasonic Velocity U (ms^{-1})	Density ρ ($Kg\ m^{-3}$)	Viscosity η x 10^{-3} (Nm^{-2} s)
0.00	1161.6	792.2	1.477
0.08	1166.0	821.2	1.327
0.16	1170.4	853.2	1.161
0.24	1172.8	882.1	1.065
0.33	1170.8	909.0	0.998
0.42	1173.2	942.3	0.897
0.52	1174.4	972.4	0.846
0.63	1177.6	1000.3	0.790
0.75	1194.4	957.1	0.695
0.87	1197.2	1059.8	0.744
1.00	1214.8	1087.8	0.746

The ultrasonic velocity increases with increase in concentration of chlorobenzene in chlorobenzene-1-propanol system at 303K, 308K, and 313K. This trend suggests that the dipole - dipole interactions are more at higher concentration of chlorobenzene in the binary mixture. When the temperature is increased in chlorobenzene-1-propanol system, the ultrasonic velocity decreases. This trend reveals that at higher temperature the molecular interactions between the components are low.

The plots of ultrasonic velocity versus mole fraction of chlorobenzene for chlorobenzene 1-propanol system at three different temperatures are given in fig.1.

Table 4 Ultrasonic Velocity (U), density (ρ), and viscosity (η) values For the binary Mixture of chlorobenzene-benzyl alcohol at 303 K

Mole fraction of Chlorobenzene	Ultrasonic Velocity U (ms^{-1})	Density ρ ($Kg\ m^{-3}$)	Viscosity η x 10^{-3} (Nm^{-2} s)
0.0	1707.6	1038.1	4.528
0.1	1584.8	1042.5	3.655
0.2	1446.8	1048.9	2.925
0.3	1420.4	1054.2	2.384
0.4	1385.2	1059.9	1.941
0.5	1356.0	1065.2	1.612
0.6	1332.0	1072.1	1.343
0.7	1311.2	1075.1	1.147
0.8	1290.8	1082.4	0.924
0.9	1266.0	1087.0	0.812
1.0	1258.4	1094.8	0.703

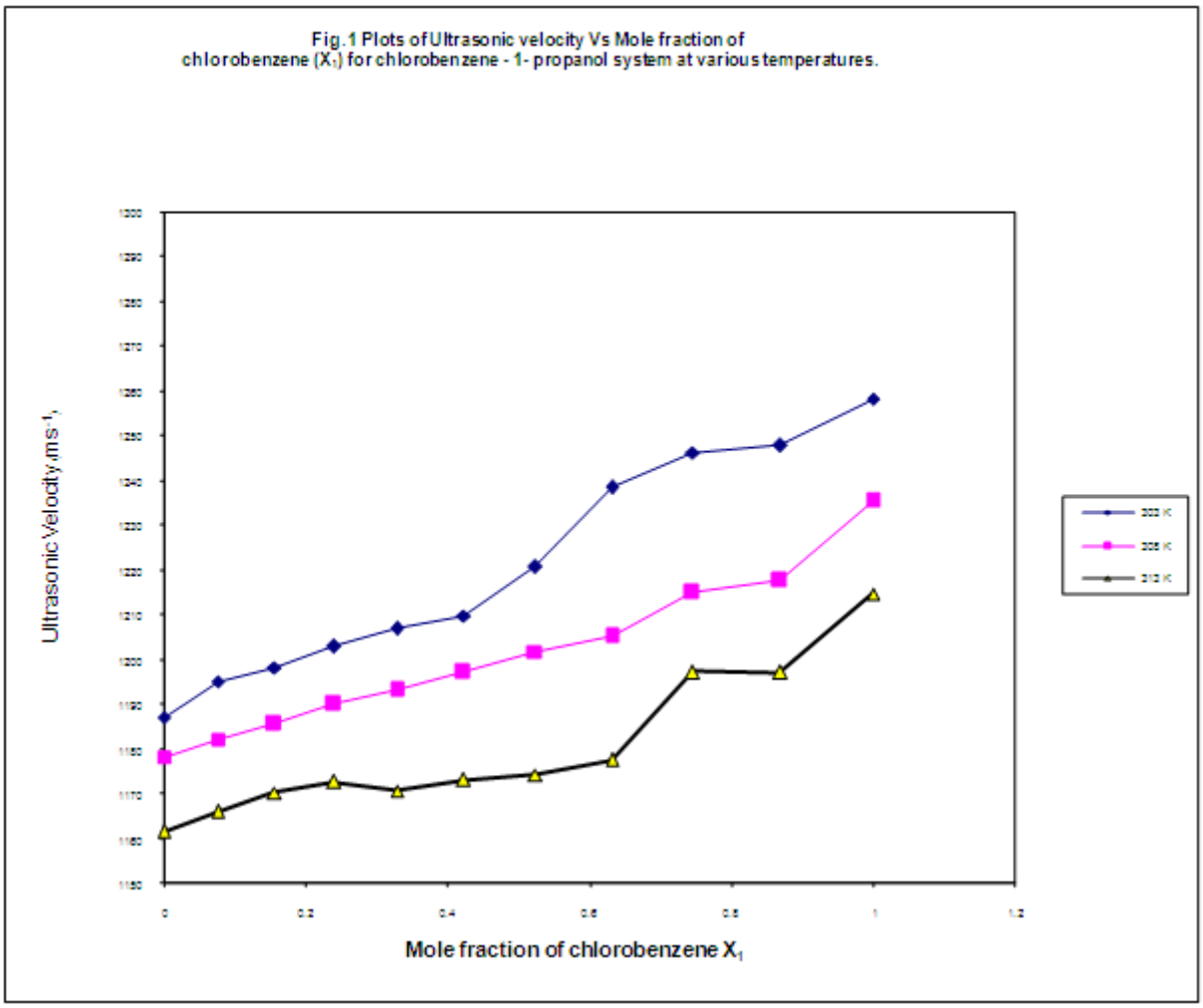
Table 5 Ultrasonic Velocity (U), density (ρ), and viscosity (η) values For the binary Mixture of chlorobenzene-benzyl alcohol at 308 K

Mole fraction of Chlorobenzene	Ultrasonic Velocity U (ms^{-1})	Density ρ ($Kg\ m^{-3}$)	Viscosity η x 10^{-3} (Nm^{-2} s)
0.0	1685.6	1037.4	4.065
0.1	1454.4	1042.3	3.382
0.2	1442.0	1048.6	2.821
0.3	1413.6	1054.1	2.266
0.4	1374.0	1059.6	1.857
0.5	1351.2	1063.8	1.500
0.6	1323.2	1071.4	1.272
0.7	1293.6	1075.0	1.100
0.8	1281.6	1081.1	0.903
0.9	1264.8	1086.4	0.784
1.0	1235.6	1092.6	0.684

Table 6 Ultrasonic Velocity (U), density (ρ), and viscosity (η) values For the binary Mixture of chlorobenzene-benzyl alcohol at 313 K

Mole fraction of Chlorobenzene	Ultrasonic Velocity U (ms^{-1})	Density ρ ($Kg\ m^{-3}$)	Viscosity η x 10^{-3} (Nm^{-2} s)
0.0	1678.8	1034.3	3.719
0.1	1448.8	1040.7	3.335
0.2	1423.6	1046.7	2.771
0.3	1391.2	1051.6	2.200
0.4	1350.8	1056.9	1.810
0.5	1330.0	1062.9	1.506
0.6	1319.2	1069.3	1.223
0.7	1287.2	1073.0	1.059
0.8	1250.0	1079.1	0.887
0.9	1232.4	1084.2	0.778
1.0	1214.8	1087.9	0.667

For chlorobenzene-benzyl alcohol system at three different temperatures, the ultrasonic velocity decreases with increase in concentration of chlorobenzene in each temperature. This trend suggests that the dipole-dipole interactions decrease when the concentration of chlorobenzene increases in the system due to steric effect. When the temperature of the chlorobenzene and benzyl alcohol system increases, molecular attraction decreases between the components fig.2.



Acoustical Parameters

The acoustic parameters for various compositions of chlorobenzene with 1-propanol and benzyl alcohol at various temperatures 303K, 308K and 313K, are calculated from the measured ultrasonic velocity, density and viscosity values. These data's are given in Tables 7-12.

Table 7 Acoustic parameters for chlorobenzene – 1-propanol binary liquid mixture at 303 K

Mole fraction of Chlorobenzene	Adiabatic compressibility $\beta \times 10^{-10}$ ($Kg^{-1}ms^2$)	Free length L_f (A°)	Acoustic impedance $Z \times 10^5$ ($Kg^{-2}ms^{-1}$)	Relaxation time $\tau \times 10^{-12}$ (s)	Free volume $V_f \times 10^{-8}$ (ml)	Available volume $V_a \times 10^{-5}$ (m^3)	Internal pressure π_i (atm)
0.00	8.931	5.977	9.431	1.919	3.328	1.952	8671
0.08	8.492	5.828	9.852	1.605	4.483	1.966	7712
0.16	8.132	5.703	10.261	1.385	5.785	2.000	6965
0.24	7.791	5.582	10.668	1.233	7.142	2.032	6373
0.33	7.498	5.476	11.048	1.077	9.115	2.075	5756
0.42	7.213	5.371	11.457	0.951	11.425	2.119	5239
0.52	6.876	5.244	11.914	0.845	14.116	2.127	4779
0.63	6.485	5.093	12.447	0.734	17.918	2.095	4317
0.75	6.227	4.991	12.884	0.683	20.844	2.122	4013
0.87	6.026	4.910	13.297	0.649	23.563	2.182	3769
1.00	5.765	4.802	13.783	0.617	26.458	2.194	3542

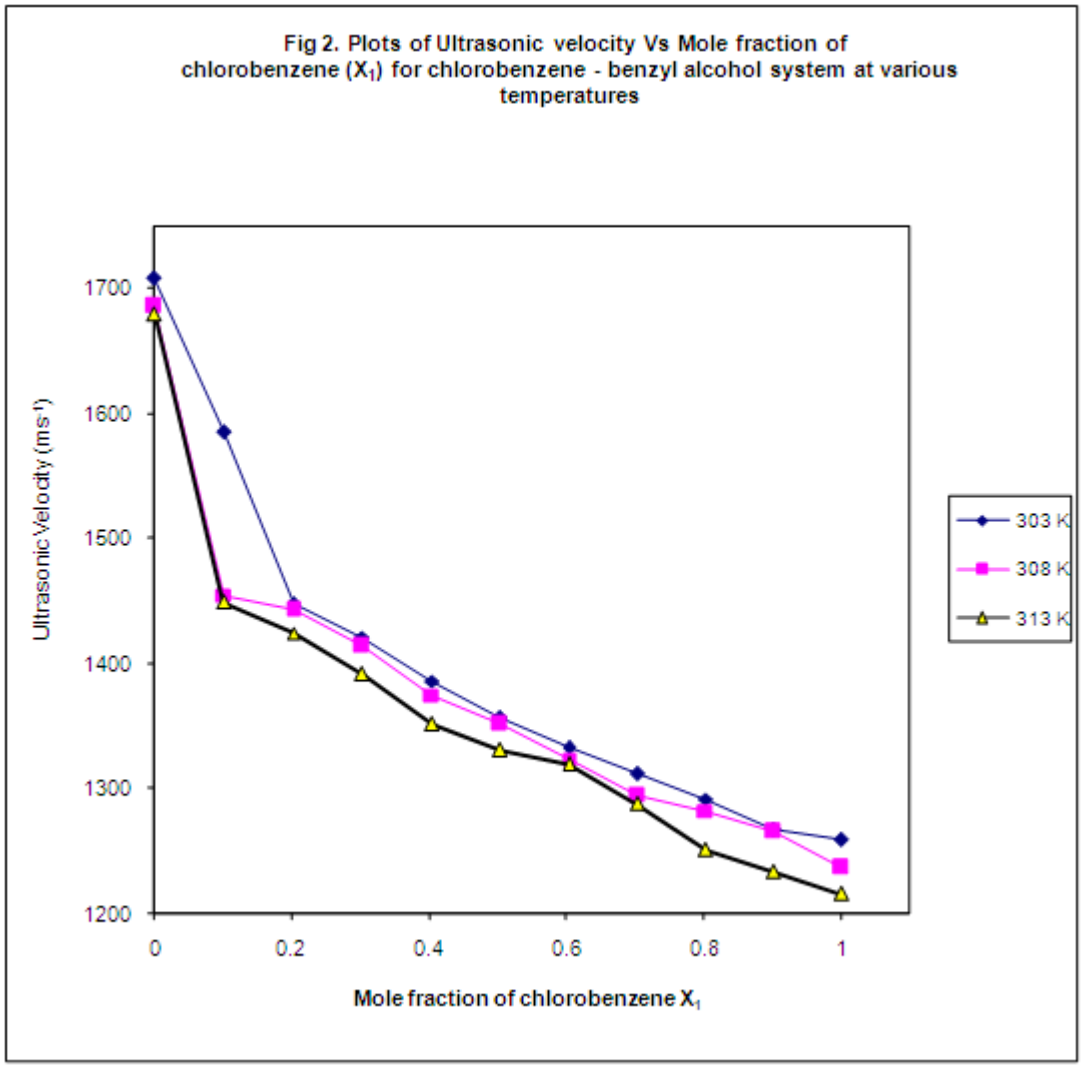


Table 8 Acoustic parameters for chlorobenzene – 1-propanol binary liquid mixture at 308 K

Mole fraction of Chlorobenzene	Adiabatic compressibility β x10^{-10} (Kg $^{-1}$ms^2)	Free length L_f (A°)	Acoustic impedance Z x 10^5 (Kg $^{-2}$ ms^{-1})	Relaxation time τ x 10^{-12} (s)	Free volume V_f x 10^{-8} (ml)	Available volume V_a x10^{-5} (m^3)	Internal pressure π_i (atm)
0.00	9.080	6.0267	9.346	1.892	3.445	1.997	8704
0.08	8.701	5.899	9.721	1.597	4.610	2.034	7753
0.16	8.327	5.771	10.130	1.360	6.064	2.069	6960
0.24	7.991	5.654	10.516	1.177	7.822	2.107	6271
0.33	7.697	5.549	10.888	1.042	9.789	2.155	5702
0.42	7.393	5.438	11.298	0.910	12.457	2.196	5162
0.52	7.096	5.328	11.724	0.814	15.286	2.234	4729
0.63	6.868	5.241	12.081	0.752	18.074	2.295	4369
0.75	7.0623	5.315	11.651	0.683	24.235	2.489	3689
0.87	6.354	5.041	12.926	0.640	25.093	2.379	3743
1.00	5.995	4.897	13.500	0.618	27.231	2.346	3560

Table 9 Acoustic parameters for chlorobenzene – 1-propanol binary liquid mixture at 313 K

Mole fraction of Chlorobenzene	Adiabatic compressibility $\beta \times 10^{-10}$ ($Kg^{-1} ms^2$)	Free length L_f (A°)	Acoustic impedance $Z \times 10^5$ ($Kg^{-2} ms^{-1}$)	Relaxation time, $\tau \times 10^{-12}$ (s)	Free volume $V_f \times 10^{-8}$ (ml)	Available volume $V_a \times 10^{-5}$ (m^3)	Internal pressure π_i (atm)
0.00	9.355	6.117	9.202	1.842	3.670	2.079	8654
0.08	8.957	5.986	9.575	1.585	4.770	2.112	7784
0.16	8.556	5.850	9.986	1.325	6.442	2.147	6926
0.24	8.242	5.742	10.345	1.170	8.087	2.199	6295
0.33	8.026	5.666	10.643	1.068	9.760	2.282	5786
0.42	7.710	5.553	11.055	0.922	12.623	2.330	5218
0.52	7.456	5.461	11.420	0.841	15.133	2.396	4812
0.63	7.209	5.370	11.780	0.760	18.492	2.461	4400
0.75	7.324	5.413	11.432	0.679	25.146	2.628	3699
0.87	6.583	5.132	12.688	0.653	25.037	2.510	3802
1.00	6.229	4.992	13.215	0.620	28.002	2.491	3573

Table 10 Acoustic parameters for chlorobenzene – benzyl alcohol binary liquid mixture at 303 K

Mole fraction of Chlorobenzene	Adiabatic compressibility $\beta \times 10^{-10}$ ($Kg^{-1} ms^2$)	Free length L_f (A°)	Acoustic impedance $Z \times 10^5$ ($Kg^{-2} ms^{-1}$)	Relaxation time $\tau \times 10^{-12}$ (s)	Free volume $V_f \times 10^{-8}$ (ml)	Available volume $V_a \times 10^{-5}$ (m^3)	Internal pressure π_i (atm)
0.0	3.304	3.635	17.727	1.994	2.942	- 0.701	7299
0.1	3.819	3.909	16.522	1.861	3.649	0.010	6794
0.2	4.555	4.268	15.175	1.776	4.473	0.995	6356
0.3	4.702	4.337	14.974	1.495	5.948	1.166	5784
0.4	4.917	4.435	14.682	1.273	7.845	1.392	5279
0.5	5.106	4.519	14.444	1.098	10.100	1.580	4856
0.6	5.257	4.586	14.280	0.942	13.009	1.731	4470
0.7	5.410	4.652	14.097	0.828	16.188	1.868	4153
0.8	5.545	4.710	13.972	0.683	22.000	1.994	3756
0.9	5.740	4.792	13.761	0.622	26.092	2.153	3549
1.0	5.768	4.803	13.777	0.541	32.282	2.195	3313

Table 11Acoustic parameters for chlorobenzene – benzyl alcohol binary liquid mixture at 308 K

Mole fraction of Chlorobenzene	Adiabatic compressibility $\beta \times 10^{-10}$ ($Kg^{-1} ms^2$)	Free length L_f (A°)	Acoustic impedance $Z \times 10^5$ ($Kg^{-2} ms^{-1}$)	Relaxation time $\tau \times 10^{-12}$ (s)	Free volume $V_f \times 10^{-8}$ (ml)	Available volume $V_a \times 10^{-5}$ (m^3)	Internal pressure π_i (atm)
0.0	3.430	3.704	17.364	1.701	3.852	-0.515	6875
0.1	4.578	4.279	15.078	2.036	3.659	0.986	7004
0.2	4.714	4.342	14.901	1.741	4.736	1.148	6433
0.3	4.913	4.433	14.630	1.441	6.508	1.359	5789
0.4	5.185	4.554	14.277	1.251	8.391	1.620	5322
0.5	5.319	4.612	14.137	1.068	10.870	1.752	4887
0.6	5.374	4.636	14.106	0.876	14.755	1.819	4420
0.7	5.625	4.743	13.812	0.794	17.753	2.027	4154
0.8	5.931	4.871	13.489	0.701	22.314	2.264	3854
0.9	6.0723	4.929	13.362	0.630	26.741	2.376	3630
1.0	6.229	4.992	13.216	0.554	33.164	2.491	3378

ADIABATIC COMPRESSIBILITY (β)

The plots of adiabatic compressibility against mole fraction of chlorobenzene of 1-propanol-chlorobenzene binary mixture at 303K, 308K and 313K are given in fig.3

According to Forte and Moore [16] hydrogen bonding between unlike components makes a negative contribution to compressibility. It may be noted that in the three different temperatures, the β value decreases with increase in concentration of the first component indicating the possibility of stronger interactions at higher concentration. It is also observed that the interactions are more at lower temperature at a specific concentration.

Fig.4 contains the plots of adiabatic compressibility versus mole fraction of chlorobenzene in chlorobenzene-benzyl alcohol system at 303K, 308K and 313K. The adiabatic compressibility value increases with increase in concentration of chlorobenzene in all the three different temperatures. This trend shows that the molecular attractions are more at lower concentration of chlorobenzene and at higher concentrations the attractions are less due

to steric hindrance and for chlorobenzene-benzyl alcohol system the dipole-dipole interactions are more at higher temperature than at lower temperature.

Fig 3. Plots of Adiabatic compressibility Vs Mole fraction of chlorobenzene (X_1) for chlorobenzene-1-propanol system at various temperatures.

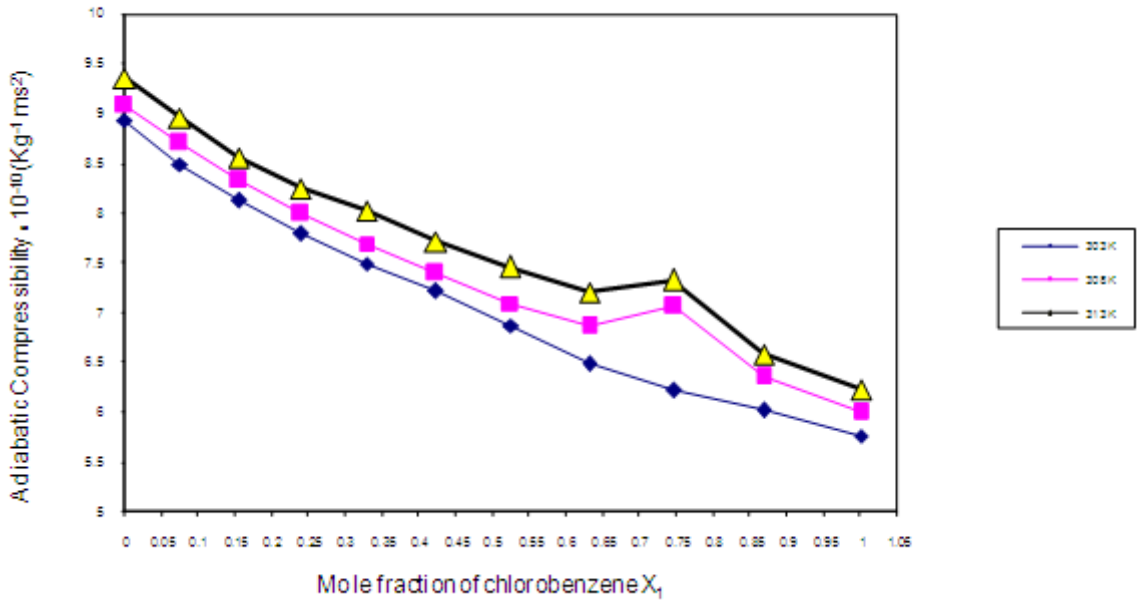
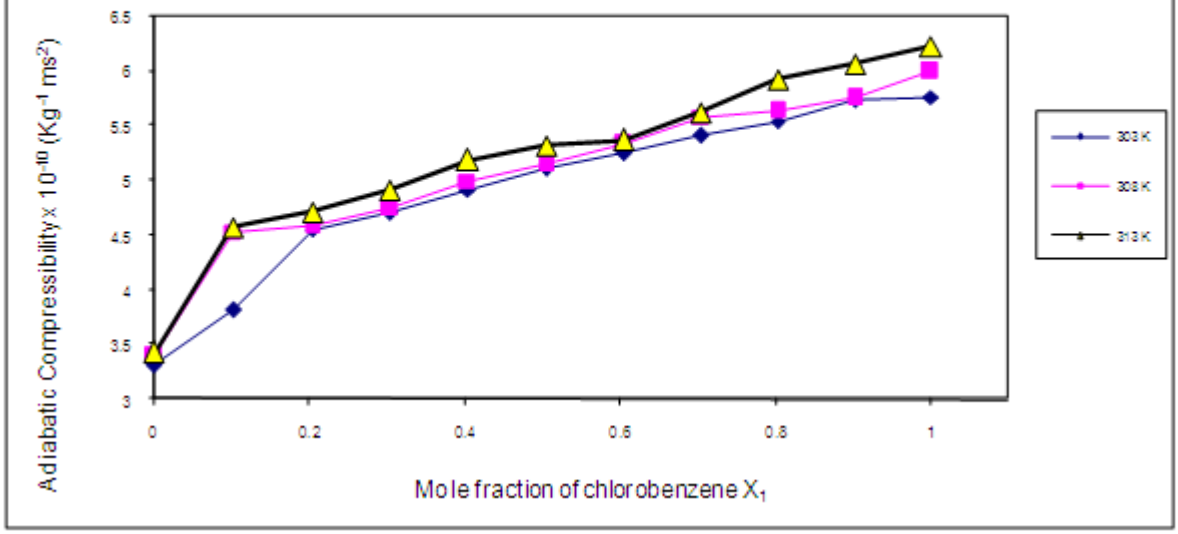


Fig 4. Plots of Adiabatic compressibility Vs Mole fraction of chlorobenzene (X_1) for chlorobenzene - benzyl alcohol system at various temperatures



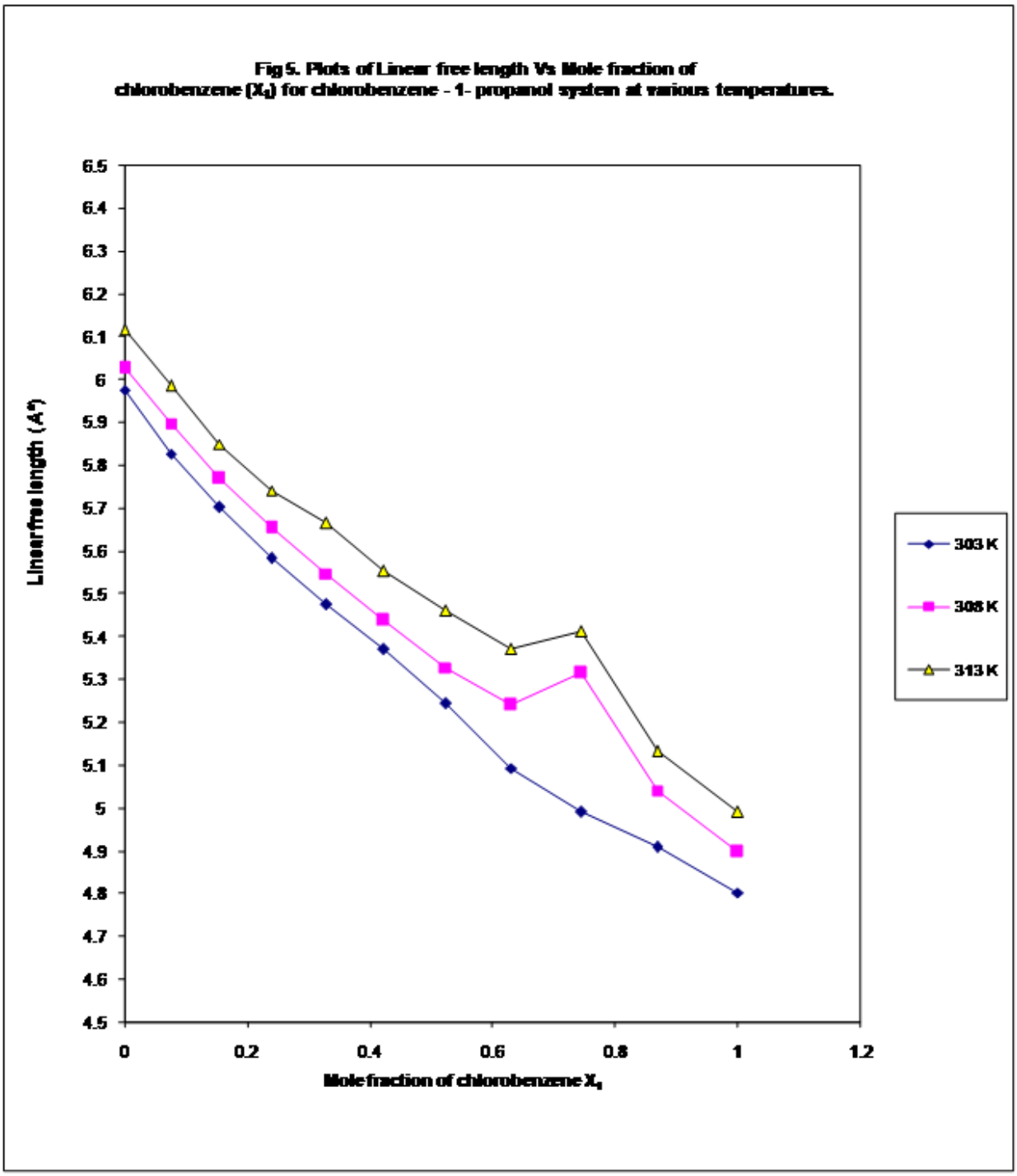
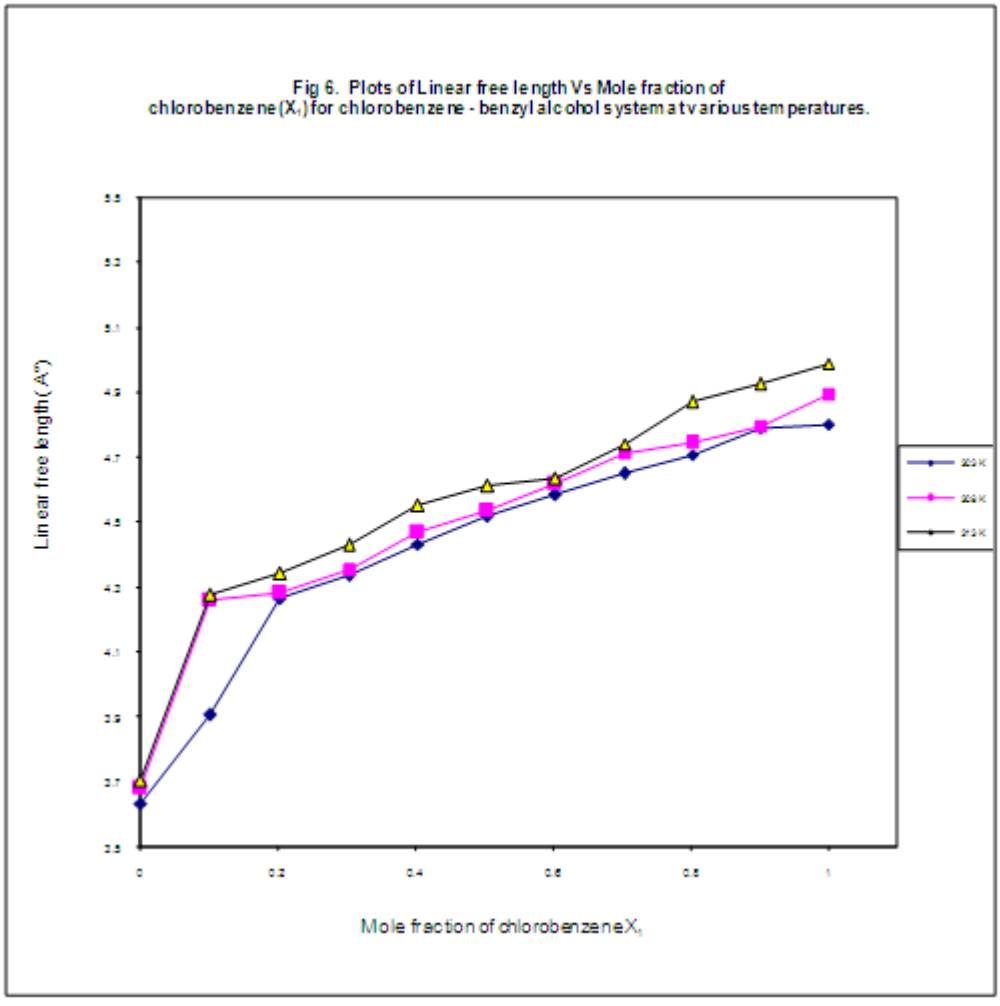


Fig. 6 contains plots of linear free length against mole fraction of chlorobenzene for chlorobenzene - benzyl alcohol system at 303K, 308K and 313K

Table 12 Acoustic parameters for chlorobenzene – benzyl alcohol binary liquid mixture at 313 K

Mole fraction of Chlorobenzene	Adiabatic compressibility $\beta \times 10^{-10}$ ($Kg^{-1}ms^2$)	Free length L_f (A°)	Acoustic impedance $Z \times 10^5$ ($Kg^{-2}ms^{-1}$)	Relaxation time $\tau \times 10^{-12}$ (s)	Free volume $V_f \times 10^{-8}$(ml)	Available volume $V_a \times 10^{-5}$ (m^3)	Internal pressure π_i (atm)
0.0	3.430	3.704	17.364	1.701	3.852	-0.515	6875
0.1	4.578	4.279	15.078	2.036	3.659	0.986	7004
0.2	4.714	4.342	14.901	1.741	4.736	1.148	6433
0.3	4.913	4.433	14.630	1.441	6.508	1.359	5789
0.4	5.185	4.554	14.277	1.251	8.391	1.620	5322
0.5	5.319	4.612	14.137	1.068	10.870	1.752	4887
0.6	5.374	4.636	14.106	0.876	14.755	1.819	4420
0.7	5.625	4.743	13.812	0.794	17.753	2.027	4154
0.8	5.931	4.871	13.489	0.701	22.314	2.264	3854
0.9	6.0723	4.929	13.362	0.630	26.741	2.376	3630
1.0	6.229	4.992	13.216	0.554	33.164	2.491	3378



LINEAR FREE LENGTH (L_f)

The free length of a system is a measure of intermolecular attraction between the components in binary mixtures. This increase in free length indicates weakening of intermolecular attraction. As the ultrasonic velocity increases due to the increase in concentration, the intermolecular free length has to decrease and vice versa [17].

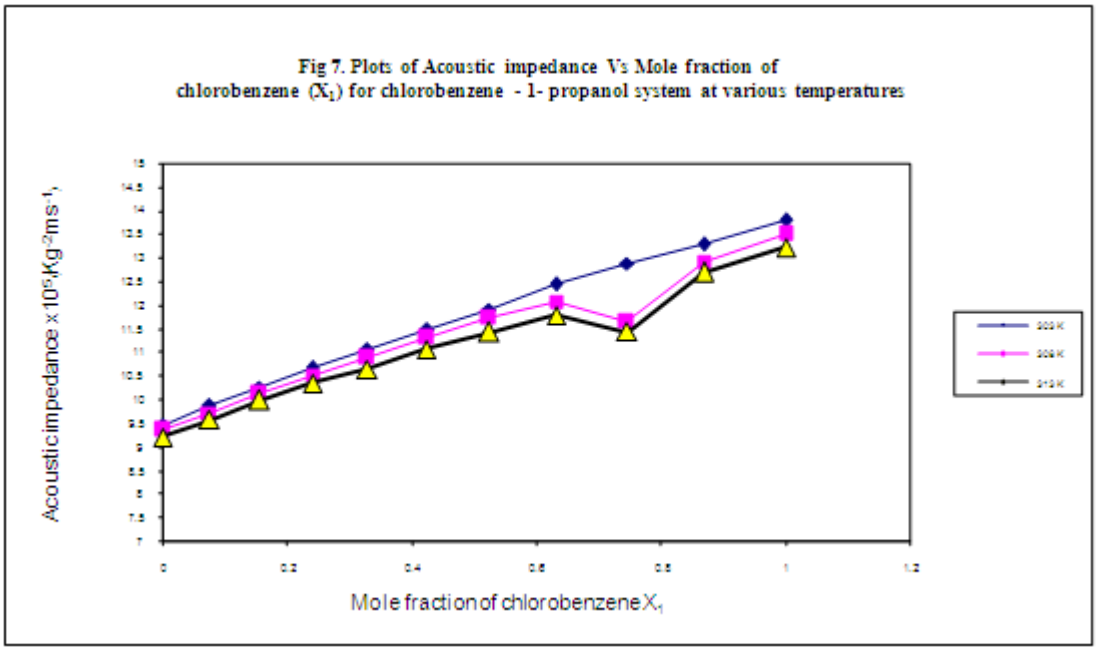
The linear free length values decreases with increase in concentration of chlorobenzene in chlorobenzene-1-propanol system at the three different temperatures which shows that the dipole-dipole interactions are more at higher concentration of chlorobenzene in all the systems. But the trend is reverse in case of chlorobenzene-benzyl

alcohol system at all the three different temperatures which indicates the strong attractions present in lower concentration of chlorobenzene. Fig.5 contains plots of linear free length against mole fraction of chlorobenzene for chlorobenzene - 1- propanol system at 303K, 308K and 313K.

ACOUSTIC IMPEDANCE (Z)

The acoustic impedance increases uniformly in chlorobenzene- 1-propanol system at all the temperatures investigated. The increase in acoustic impedance with concentration can be explained on the basis of lyophobic interaction between solute and solvent molecules [18, 19]. The plots of acoustic impedance versus mole fraction of chlorobenzene in chlorobenzene-1-propanol system at different temperatures are given in fig.7.

The plots of acoustic impedance versus mole fraction of chlorobenzene in chlorobenzene-benzyl alcohol system at the temperatures investigated are given in fig.8. The acoustic impedance values decreases with increase in concentration in chlorobenzene - benzyl alcohol systems.



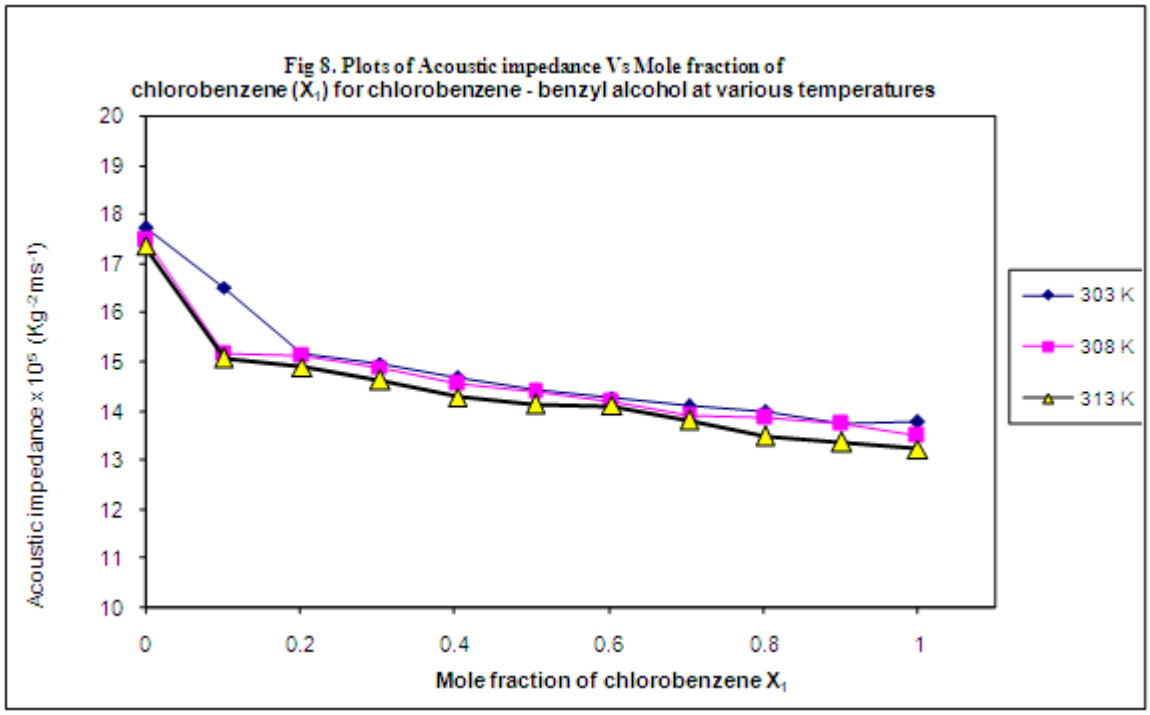


Fig 9. Plots of Relaxation time Vs Mole fraction of chlorobenzene (X_1) for chlorobenzene - 1-propanol system at various temperatures

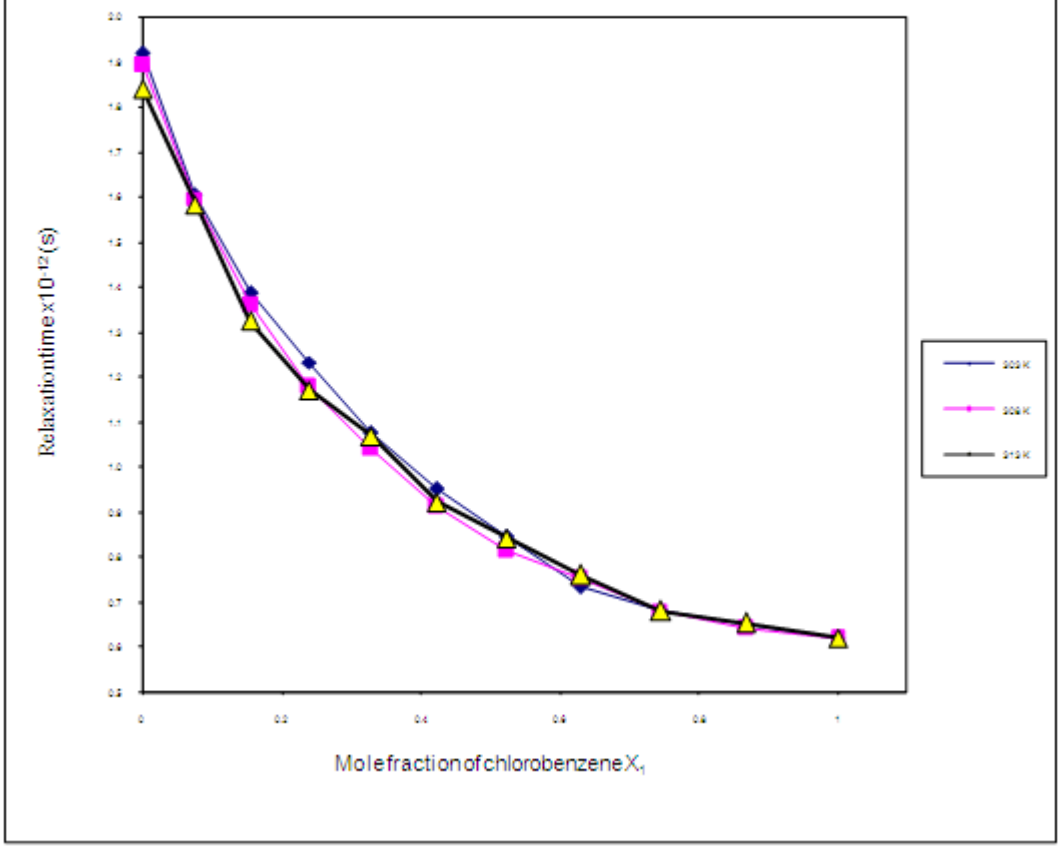
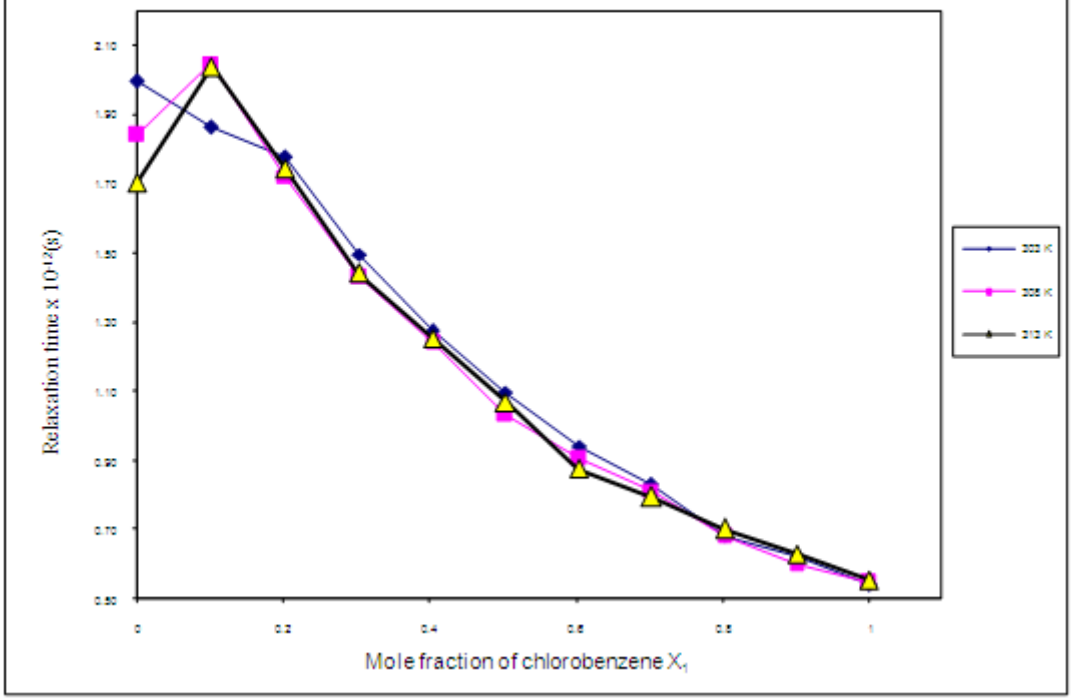
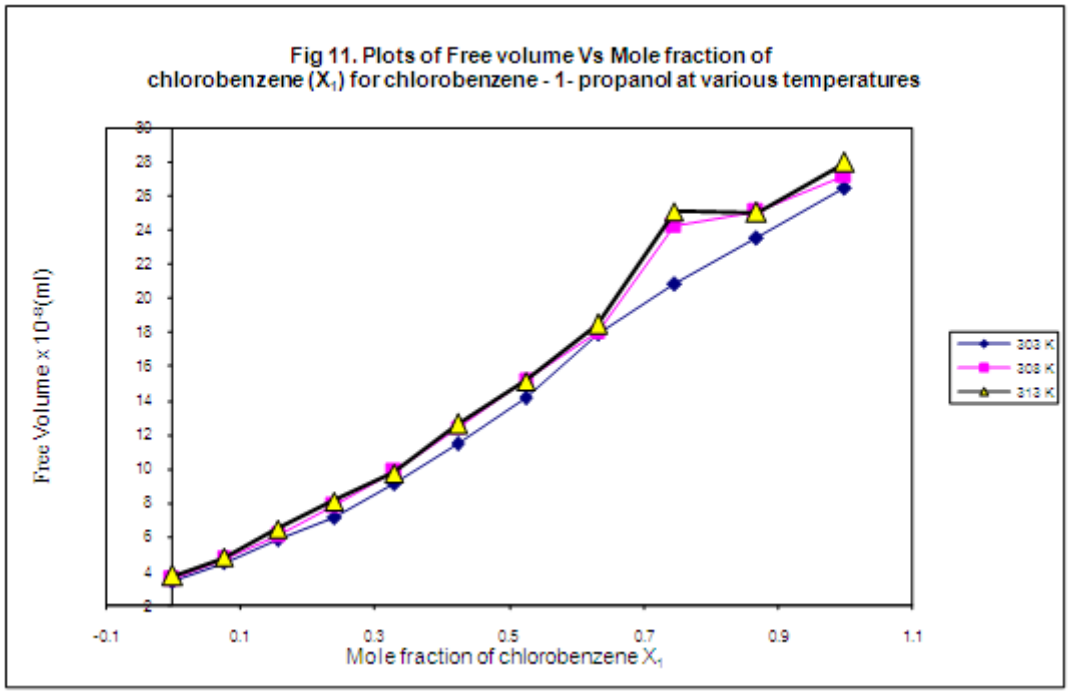
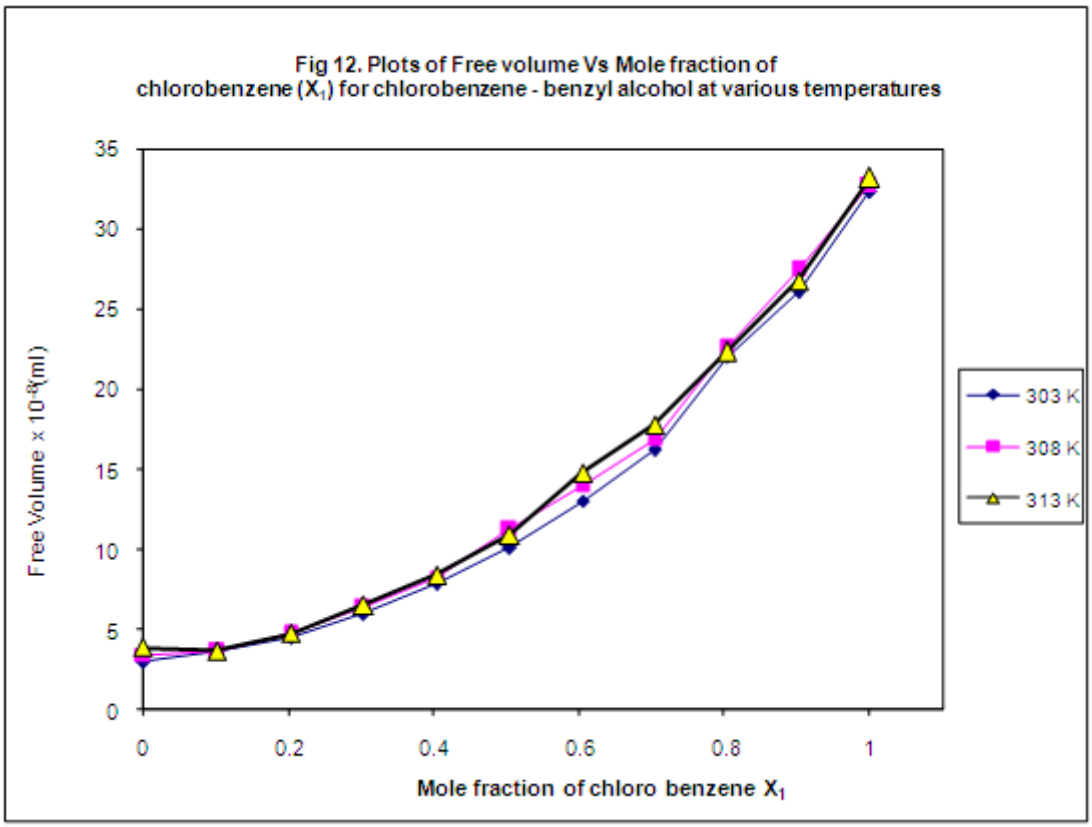


Fig 10. Plots of Relaxation time Vs Mole fraction of chlorobenzene (X_1) for chlorobenzene - benzyl alcohol system at various temperatures







RELAXATION TIME(τ)

Tables 7-12 contain the relaxation time values for two systems at three different temperatures. Figures 9 and 10 contain plots of relaxation time against mole fraction of chlorobenzene for chlorobenzene -1-propanol system and chlorobenzene - benzyl alcohol system respectively. In chlorobenzene-1-propanol system, the relaxation time increases at lower concentration and decreases at higher concentration of chlorobenzene in all the systems. This shows that the molecular interaction is strong at lower concentration and relatively weak at higher concentration. The same trend is present in chlorobenzene-benzyl alcohol systems also

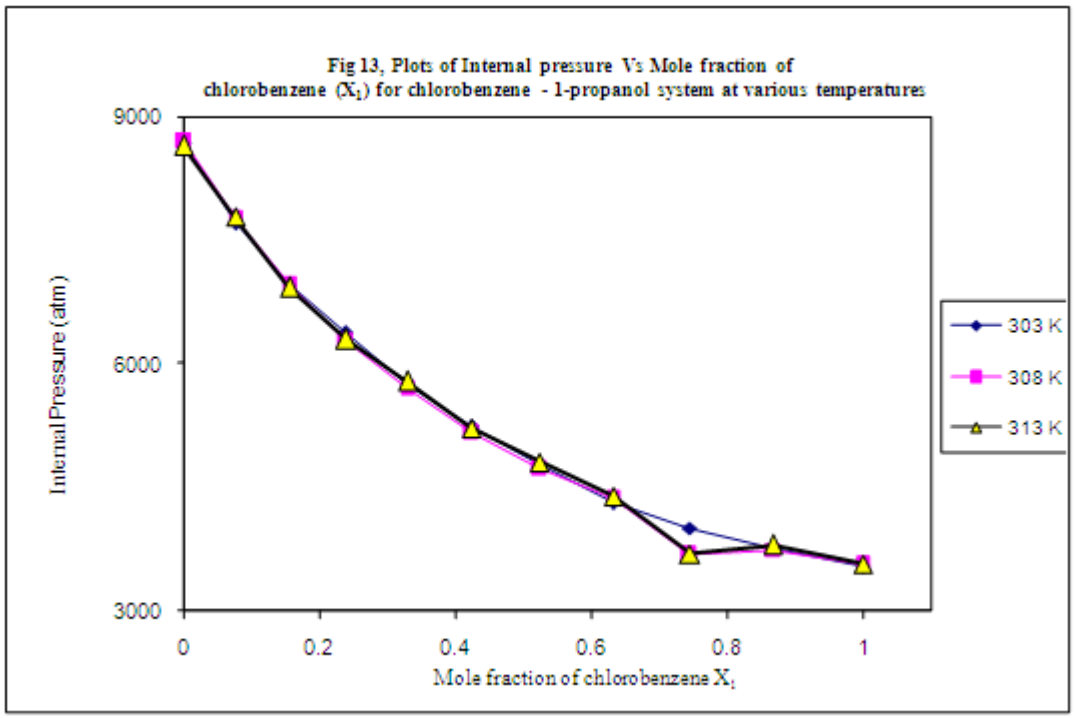
FREE VOLUME (V_f)

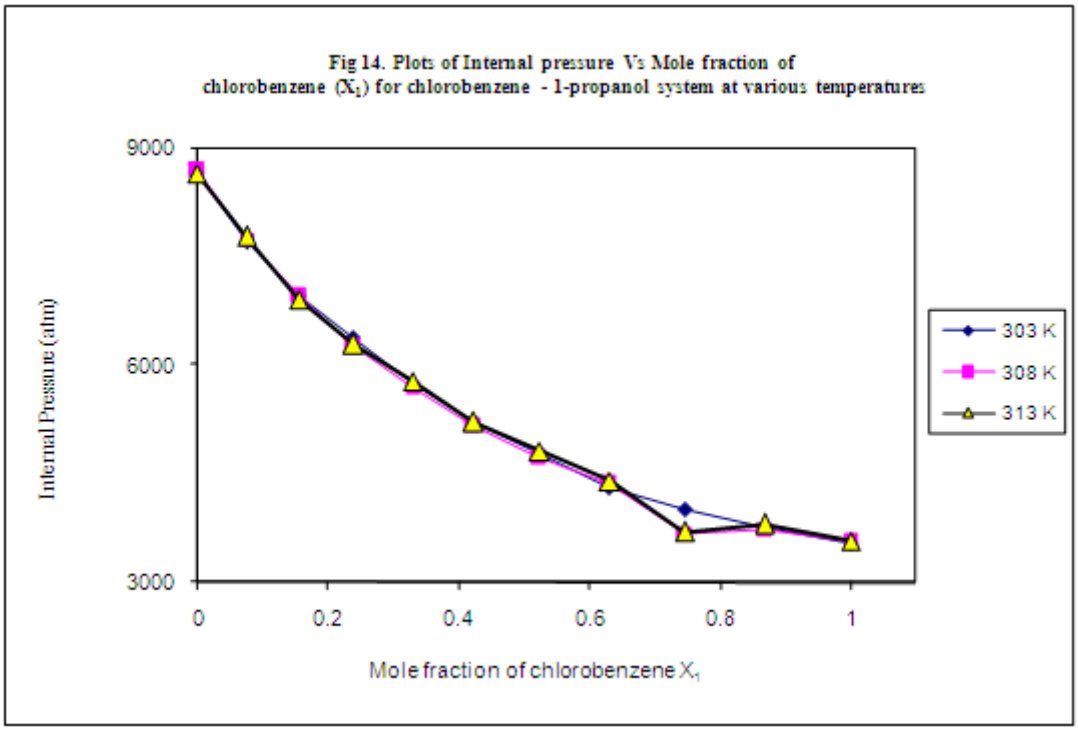
Tables 7-12 contain the free volume values for two systems at three different temperatures. Fig.11 contains plots of free volume against mole fraction of chlorobenzene for chlorobenzene - 1-propanol system at 303K, 308K and 313K. Fig 12 contains plots of free volume against mole fraction of chlorobenzene for chlorobenzene -benzyl alcohol system at 303K, 308K and 313K.

The trend present in chlorobenzene-1-propanol and chlorobenzene-benzyl alcohol systems is that the free volume increases with increase in concentration of first component.

INTERNAL PRESSURE (π_i)

The internal pressure in a binary liquid mixture is a measure of cohesive forces between the components. The internal pressure values for all the systems have been obtained from the equation suggested by Suryanarayana [20] Tables 7-12 contain the internal pressure values for chlorobenzene -1-propanol system at three different temperatures. Fig 13 contains the plots of internal pressure against mole fraction of chlorobenzene for chlorobenzene -1-propanol of the three systems. The internal pressure values decreases when the concentration of chlorobenzene decreases which shows the strong interaction present at lower concentration. It is also interesting to observe that the free volume of the system increases as internal pressure decreases.





The variation of internal pressure with respect to the mole fraction of chlorobenzene in chlonobenzene-benzyl alcohol system at 303K, 308K and 313K is given in fig.14. The internal pressure value decreases when the free volume of the system increases.

CONCLUSION

In the present study, it can be inferred that there are intermolecular interactions among the components of the binary mixtures, leading to the possible hydrogen bond formation of the type Cl...H-O- between the two components of each binary system.The molecular attraction increases with increase in the concentration of chlorobenzene in chlorobenezene-1-propanol system investigated. But the molecular interaction decreases with increase in concentration of chlorobenzene in chlorobenzene-benzyl alcohol system due to steric hindrance. In both the system when the temperature increases, the interaction between the components decreases.

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