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THERMAL ACOUSTIC STUDY OF TETRAHYDROFURAN WITH AMYL ALCOHOL USING ULTRASONIC TECHNIQUE AT DIFFERENT TEMPERATURES

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ABSTRACT:

The ultrasonic velocity (u) and density (ρ) has been measured for binary liquid mixture of Tetrahydrofuran with Amyl alcohol at different temperatures (303.15K, 308.15K and 313.15 K) for a constant frequency (2 MHz). Acoustic parameters like isentropic compressibility (β_s), intermolecular free length (L_f), and molar volume (Vm) for the solution have been computed. The excess values of the parameters are also calculated and discussed.

Keywords: Ultrasonic velocity, density, binary liquid mixture, isentropic compressibility, intermolecular free length.

INTRODUCTION:

Ultrasonic wave propagation affects the physical properties of the medium and hence can furnish information about molecular interaction of the liquid and liquid mixtures. Vibrational waves of a frequency above the hearing range of the normal ears i.e., 16 to 20,000 cycles per second are referred as ultrasonic. Curie brothers (1880) discovered the phenomenon of "piezoelectric effect" which is the development of electric charges on the definite faces of some crystals like quartz. Since quartz crystals possess the piezoelectric property to a greater extent, they are highly stable, strong and hard is used as transducer for the purpose of research work on ultrasonic.

Thermo acoustical studies of binary liquid mixtures has been become more demanded as it provides precise predictions of behavior of molecules in liquid mixtures. Study of behavior of molecules in liquid act as tool to understand intermolecular interaction.

Ultrasonic velocity has been adequately employed in understanding the nature of molecular interactions in pure liquids, (1) binary and ternary mixtures (2-4). The ultrasonic velocity measurements find wide application in characterizing the physico-chemical behavior of liquid mixtures (5-7). Thermodynamic studies of liquid mixtures are useful to understand the different type of interaction i.e., dipole-dipole (8-11), and dipole induced dipole (12-15), between polar-polar (16-17), and non-polar system(18-21). Ultrasonic velocity measurements play an important role to detect weak and strong molecular interaction in liquid mixtures (22-24). Literature survey reveals the need of knowledge of excess thermodynamic parameters of liquid mixtures.

EXPERIMENTAL DETAILS

High purity samples used in the present study were obtained from Merk Co. Inc. Germany and purified by the standard methods (25) . The liquids were distilled before use and mixed in desired proportions using burette and are allowed to stay for 5 or 6 hours to attain thermal equilibrium before experimental observations. Ultrasonic interferometer having a gold-plated X-cut quartz crystal with a frequency of 2MHz with an accuracy of ±0.1 ms^{-1} supplied by M/S Mittal enterprises (Model F-81), New Delhi, India was used in the investigation. The temperature and pure liquids and their mixtures have been maintained constant with the help of constant water bath with an accuracy of ±0.01 K. The densities of all the liquids and liquid mixtures have been measured using a 10 ml specific gravity bottle.

Employing the measurement values of velocity (v) and density (ρ) some thermodynamic properties such as isentropic compressibility (βs), intermolecular free length (L_f) and molar volume (V_m) have been computed through the following expressions (26-27) .

Molar volume

$V_m = [M^-/e]$

Isentropic compressibility

$\beta s = 1/V^2\rho$

Intermolecular free length

$Lf = [K \sqrt{\beta_s}]$

Excess values of various parameters are computed using the following relation: -

$A^E = (A)\ exp - (X_1A_1 + X_2A_2)$ where A^E is excess function (A) exp is experimental value of the mixture, A_1 and A_2 are the values for the pure components 1 and 2 whose mole fractions are X_1 and X_2.

The results obtained from these investigations have been incorporated in Table (1-3) and in Graph (1-4).

RESULT AND DISCUSSION

In the present investigation, it has been observed that ultrasonic velocity and density decreases as the temperature increases whereas isentropic compressibility, intermolecular free length and molar volume increases with the increase in temperature. The results are given in table 1,2 and 3. Table demonstrate a decrease in density with the increases in the mole fraction of amyl alcohol while velocity, isentropic compressibility, intermolecular free length, and molar volume increases with the increase in concentration of amyl alcohol. The result obtained from investigations have been incorporated in graph (1-4).

Table 1–Experimentally determined ultrasonic velocity, density, calculated excess values of isentropic compressibility, intermolecular free length and molar volume for Tetrahydrofuran with Amyl alcohol at 303.15K

Mole fraction X_1	Ultrasonic velocity (u) ms^{-1}	Density (ρ) gml^{-1}	Excess isentropic Compressibility (B_S^E) $cm^2\ dyne^{-1}$	Excess intermolecular freelength (L_f^E) A^o	Excess molar volume (V_m^E) ml $mole^{-1}$
1.0000	1246	0.8763	0.0000	0.0000	0.0000
0.9227	1248	0.8691	0.0224	0.0001	0.0291
0.8414	1248	0.8620	0.2636	0.0010	0.0502
0.7558	1252	0.8548	0.0251	0.0001	0.0831
0.6656	1254	0.8477	0.0023	0.0001	0.1077
0.5702	1252	0.8406	0.4470	0.0017	0.1339
0.4694	1256	0.8336	0.1418	0.0006	0.1506
0.3625	1258	0.8267	0.0499	0.0002	0.1563
0.2491	1256	0.8199	0.4169	0.0015	0.1499
0.1285	1258	0.8133	0.2516	0.0009	0.1170
0.0000	1260	0.8073	0.0000	0.0000	0.0000

Table 2–Experimentally determined ultrasonic velocity, density, calculated excess values of isentropic compressibility, intermolecular free length and molar volume for Tetrahydrofuran with Amyl alcohol at 308.15K

Mole fraction X_1	Ultrasonic velocity (u) ms^{-1}	Density (ρ) gml^{-1}	Excess isentropic Compressibility (B_S^E) $cm^2\ dyne^{-1}$	Excess intermolecular freelength (L_f^E) A^o	Excess molar volume (V_m^E) ml $mole^{-1}$
1.0000	1234	0.8734	0.0000	0.0000	0.0000
0.9228	1234	0.8662	0.2633	0.0010	0.0234
0.8416	1236	0.8589	0.2796	0.0011	0.0586
0.7560	1236	0.8516	0.5319	0.0019	0.0963
0.6658	1238	0.8443	0.5232	0.0019	0.1367
0.5705	1240	0.8371	0.4898	0.0018	0.1687
0.4696	1240	0.8299	0.6911	0.0026	0.2032

0.3627	1242	0.8299	0.6023	0.0022	0.2159
0.2493	1244	0.8160	0.4813	0.0018	0.2169
0.1286	1246	0.8095	0.2953	0.0011	0.1652
0.0000	1248	0.8038	0.0000	0.0000	0.0000

Table 3–Experimentally determined ultrasonic velocity, density, calculated excess values of isentropic compressibility, intermolecular free length and molar volume for Tetrahydrofuran with Amyl alcohol at 313.15K

Mole fraction X_1	Ultrasonic velocity (u) ms^{-1}	Density (ρ) gml^{-1}	Excess isentropic Compressibility (B_S^E) $cm^2\ dyne^{-1}$	Excess intermolecular freelength (L_f^E) A^o	Excess molar volume (V_m^E) ml $mole^{-1}$
1.0000	1212	0.8664	0.0000	0.0000	0.0000
0.9225	1212	0.8593	0.2992	0.0011	0.0526
0.8410	1212	0.8524	0.5726	0.0021	0.0882
0.7553	1214	0.8454	0.5815	0.0021	0.1370
0.6649	1216	0.8385	0.5677	0.0021	0.1782
0.5695	1216	0.8316	0.8060	0.0029	0.2223
0.4686	1218	0.8249	0.7419	0.0026	0.2458
0.3618	1220	0.8182	0.6588	0.0024	0.2711
0.2485	1220	0.8117	0.8046	0.0029	0.2726
0.1218	1222	0.8056	0.6149	0.0022	0.2211
0.0000	1226	0.8007	0.0000	0.0000	0.0000

CONCLUSION:

The acoustic data of ultrasonic velocity, density, and related thermodynamic parameters with their excess values of tetrahydrofuran with amyl alcohol over the whole concentration range suggest the weak interaction in the molecules of binary liquid mixtures. In the present study excess values of isentropic compressibility (β_s), intermolecular free length (L_f), and molar volume (Vm) have been found to be positive shows the weak interactions.

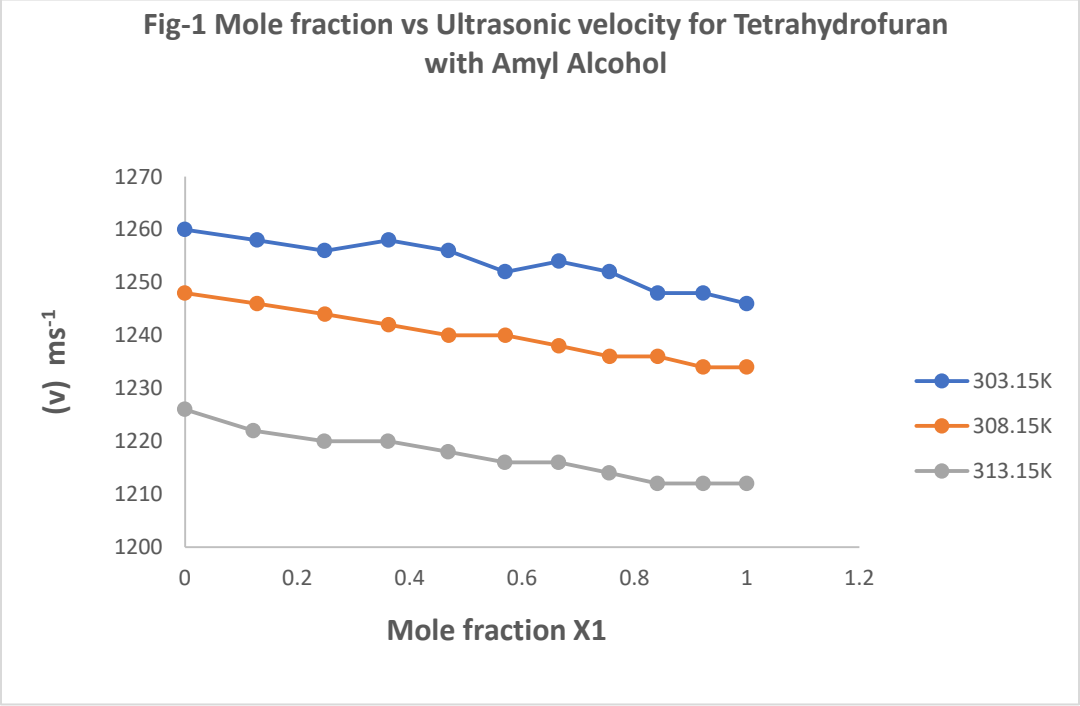


Fig-2 Mole fraction vs Isentropic compressibility for Tetrahydrofuran with Amyl Alcohol

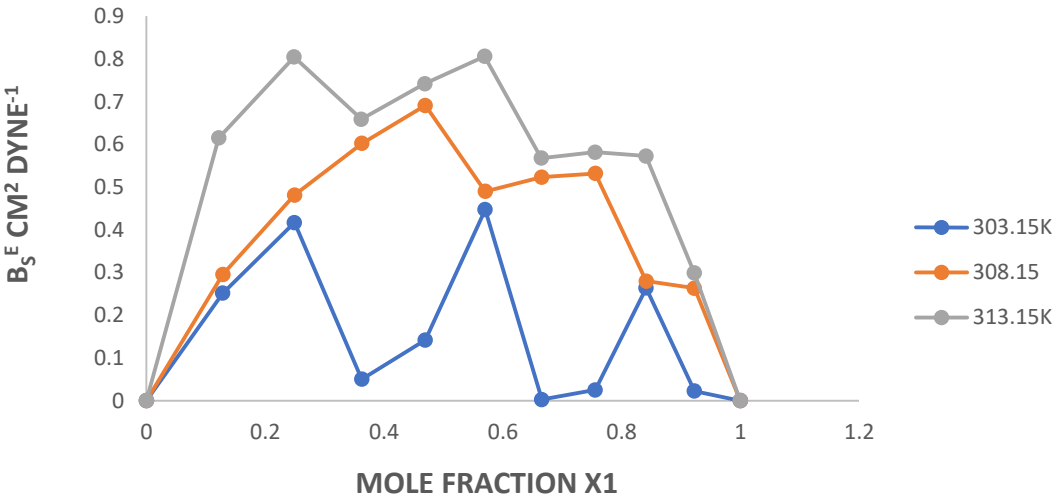


Fig-3 Mole fraction vs Excess intermolecular free length for Tetrahydrofuran with Amyl Alcohol

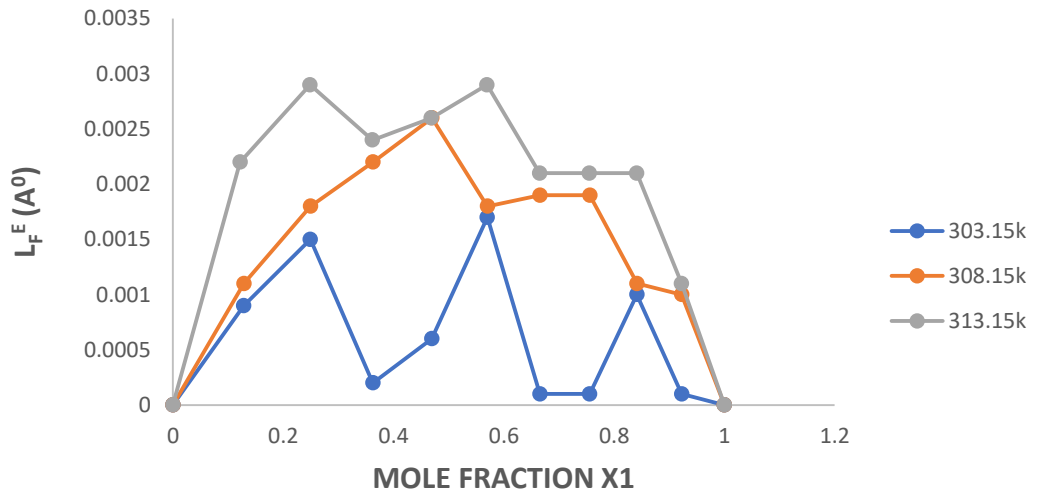
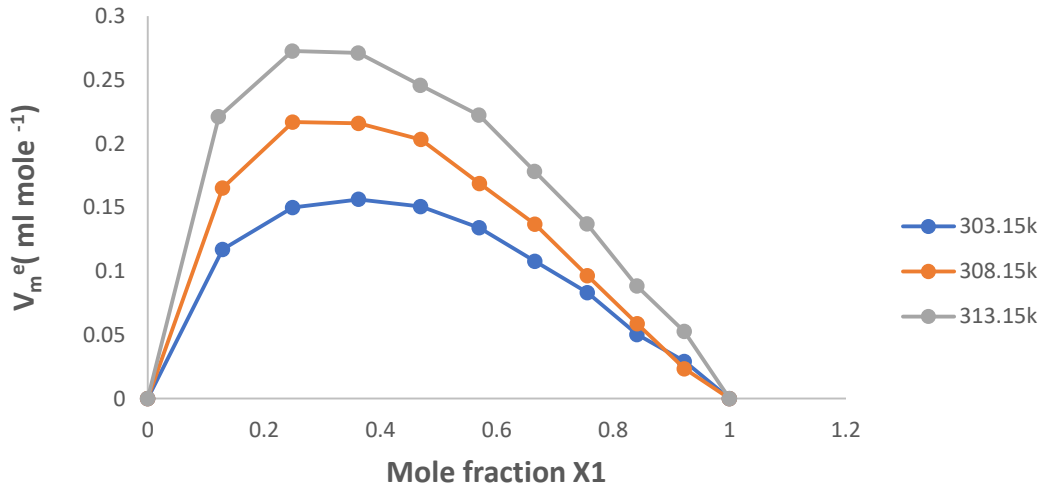


Fig -4 Mole fraction vs Excess molar volume for Tetrahydrofuran with Amyl Alcohol



REFERENCES

1. K V Laksmi, D Suhasin, M J Reddy, C Ravi, K C Rao and M C S Subha, *Indian Journal of Advance in Chemical Science*, 3(2014), 38-48.
2. P Nagarja, C N Rao and P Venkateswarla, *Indian Journal of Advance in Chemical Science*, 4(2016), 421-424.
3. J N Spencer, E Jeffrey and C Robert, *The Journal of Physical Chemistry*, 83 (1979), 1249.
4. Fort R J and Moore W R, *Trans Faraday Soc.*, 62(1966), 1112-119.
5. Kinocid, *J. Am. Chem. Soc.*, 51(1929), 2950.
6. Mehra and Sajnami, *Indian J. Pure Appl. Phys.*, 38(2000), 760.
7. Fort R J and Moore W R, *Trans Faraday Soc.*, 61(1965), 2102.
8. I Mozo, I G Fuente, J A Gonzalez and J C Cobos, *The Journal of Chemical Thermodynamics*, 42(2010) 17.
9. R Kumar, R Mahesh, B Shanmugapriyan and V Kannappan, *Indian J. Pure Appl. Phys.*, 50(2010), 633.
10. H IIoukhani, and B Samiey, *Phys. Chem. Liq.*, 45(2007), 571.
11. R Mehra and A K Gaur, *Journal of Chemical and Engineering Data*, 53(2009), 13.
12. N V Sastry, R R Thakor and M C Patel, *J. Mol. Liq.*, 114(2009), 13.
13. A J Treszczanowicz, T Treszczanowicz, *Fluid Phase Equilib.*, 135(1997), 179.
14. R Mehra and R Israni, *Indian J. Pure Appl. Phys.*,38(2000), 341.
15. R Dean, J Moulins, A Maclnnis and R M Palepu, *Phys. Chem. Liq.*, 47(2009), 302.
16. R Mehra and A K Gaur, *J. Ind. Council Chem.*, 26(2009)85.
17. R Kubendrani, F L A Khan, J Asghar, M Aravinthraj and J Udayaseelam, *J. Arch, Appl. Sci. Res.*, 3(2011)568.
18. R Mehra and R Israni,Indian *J. Chem. Technol.*, 9(2002), 34.
19. R Mehra and R Israni, *Indian J. Chem. Soc.*, 81(2004), 227.
20. R Mehra, *Z. Phys. Chem.*, 219(2005), 425.
21. R Mehra and R Israni, *J. Modern Chemistry & Chemical Technology*, 2 (2011), 24.
22. S Bahadur Alisha, S Nafeesabanu, K V S Krishana Rao, M C S Shubha, K Chowdaji Rao, *Indian Journal of Advance in Chemical Science*, 5(2017), 142-147.
23. A M Ghosh and J N Ramteke, *Der Chemica Sinica*, 8(2017), 291-297.
24. Sunita R Dandwate, *IJRBAT*, Issue (IX), Vol. II(2021), 163-170.

25. Vogel A I, *A textbook of practical Organic Chemistry, 5th* Edn (Jhon Willey, New York) (1989).

26. Subramaniyam Naidu P & Ravindra Prasad K, *Indian J. Pure Appl. Phys.*, 42(2004),512.

27. Ezhil Pavai R, Vasantharani P & Kannappan A , *Indian J. Pure Appl. Phys.*, 42(2004),934.