International Conference on Innovative Research in Engineering, Management and Sciences
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
 | Volume 4 | Issue 9 | ISSN : 2456-3307

Ultrasonic Study of Binary Mixtures of Diethyl Amine with Butyl Acetate and Ethyl Acetate

Dr. B. Rohini
Department of Physics, New Horizon College of Engineering, Bangalore, Karnataka, India

ABSTRACT

The studies of ultrasonic velocities, refractive indices are being increasingly used as tools for investigation of the pure components and the nature of inter molecular attraction between the liquid mixture constituents. The refractive indices, densities and ultrasonic velocities of binary mixtures of Butyl acetate and Ethyl Acetate with Diethyl amine have been measured at 302K.From the experimental data the various acoustical parameters such as compressibility (β), Inter molecular free length (Lf), Wada's constant(W), Molar sound fraction(R) and acoustic impedance (Z) have been measured. The molecular interaction existing between the components are also discussed.

Keywords: Ultrasonic velocity, refractive index, binary mixture, molecular interaction, acoustical parameters.

I. INTRODUCTION

Ultrasonic velocities, densities and derived acoustical parameters are of considerable interest in understanding the intermolecular interaction in binary (1-2) mixtures or liquid3, liquid mixtures. The molecular interactions studies can be carried out through non spectroscopic techniques such as dielectric4 magnetic5 ultrasonic velocity measurements have been widely used in the field of interactions and structural aspect evaluations studies. Experimental measurement of ultrasonic velocity and density are used to calculate various acoustical parameters viz. compressibility, Inter molecular free length, Wada's constant, Molar sound fraction or Rao's constant and acoustic impedance at room temperature. Diethyl amine is a protic solvent in nature its shows the various molecular interaction. In the present work an attempt has been made to investigate the behavior of binary solutions of Diethyl amine in butyl acetate and Ethyl acetate with regard to adiabatic compressibility, inter molecular free length and acoustic impedance from ultrasonic measurements at 302K.

II. THEORY AND CALCULATIONS

Ultrasonic velocity is calculated using the formula in which the frequency was 2MHz.

V = f …………..(1)

Compressibility of a liquid is one of the physical quantities in fluid mechanics. Knowing the ultrasonic velocity (v) and density (ρ) of the liquid or liquid mixture, the adiabatic compressibility is computed6 using the formula

(β) = 1/ρv2 …………(2)

Intermolecular free length is also calculated using adiabatic compressibility by Jacobson's empirical relation7

(Lf) = KJ β1/2 …………(3)

Where KJ is the Jacobson's constant which is temperature dependent and is obtained from the literature.

The ratio of temperature coefficient of sound velocity to the expansion coefficient is virtually same for all unassociated organic liquids.

$$(R)= (m/\rho)\ v1/3……….(4)$$

R is the independent of temperature and called Rao's constant8, 9, 10.

In the study of sound velocity in liquids another constant has been suggested by wada11.

$$(W) = (m/\rho)\ \beta\text{-}1/7\ ………(5)$$

"W' is the Wada's constant or molecular compressibility which is independent of temperature and pressure.

Acoustic impedance is defined by Ohm's analogue12.

$$Z = \rho V\ …………(6).$$

III. EXPERIMENTAL DETAILS

Solutions of different molecular fraction from 0.01 M to 0.06 M were prepared for each system. Solute (Diethyl amine) and solvents (Butyl acetate and Ethyl acetate) were mixed in the required proportions by mass of the solute and volume of the solvents. All the mass of the solute for different concentrations were done by using electronic balance Shimadzu cooperation, Japan type BL2205 accurate 0.01g. The possible uncertainty in the mole fraction was estimated to be less than 0.01g13. The experiment was done at room temperature. Refractive indices were measured using thermostatically controlled Abbes' refractometer with accuracy less 0.0001units. The refractive indexes for six different molar concentrations of liquid systems were measured and are tabulated in tables 1 & 2. The ultrasonic waves in the liquid mixture have been measured using ultrasonic Interferometer (Mittal Enterprises, NewDelhi) working at a fixed frequency of 2MHz. The density was measured as a function of composition of the mixture Diethyl amine with butyl acetate and Ethyl acetate at 302 K. The density was determined by using a 5 ml specific gravity bottle by relative measurement method with an accuracy of 0.01 kgm-3.

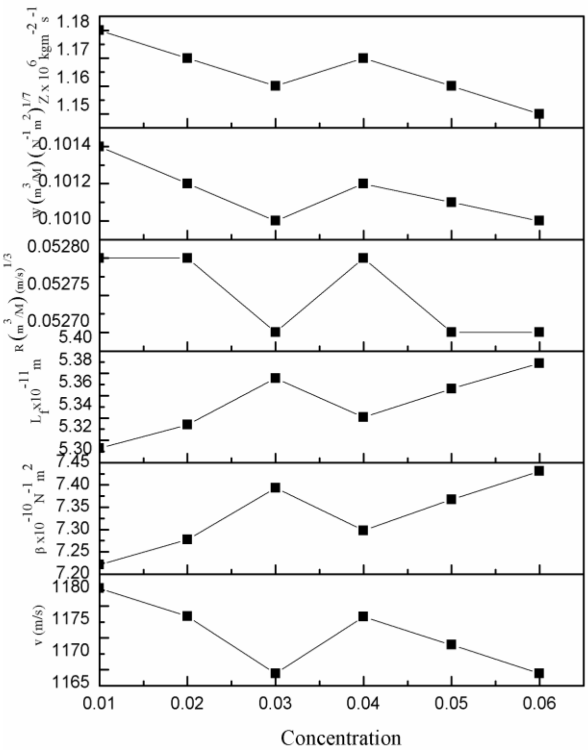

Fig. 1. Concentration vs Ultrasonic Velocity (v), Compressibility (β), Intermolecular free length (Lf), Molar sound fraction (R), Wada's constant (W) and Acoustic Impedance (Z) for the system Diethylamine+Butyl acetate.

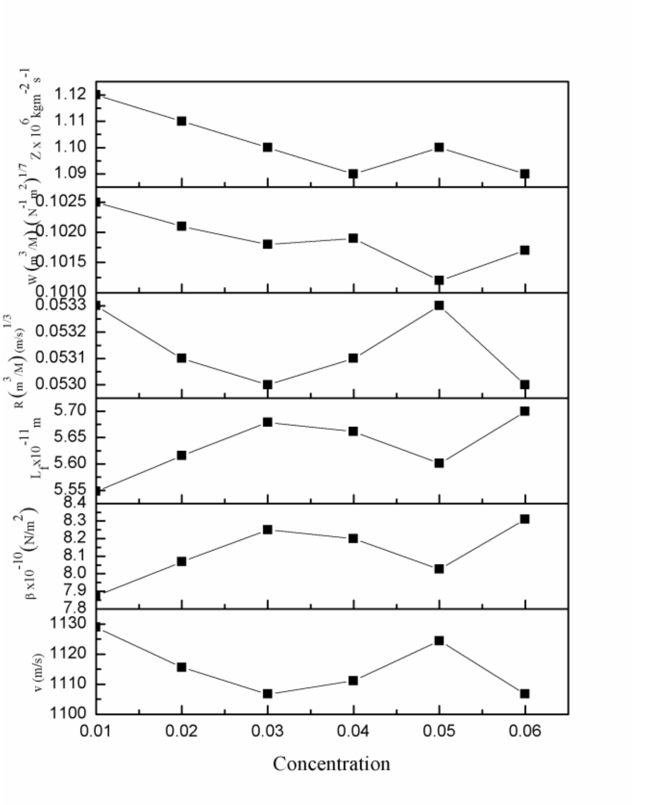

Fig.2. Concentration vs Ultrasonic Velocity (v), Compressibility (β), Intermolecular free length (Lf), Molar sound fraction (R), Wada's constant (W) and Acoustic Impedance (Z) for the system Diethylamine+Ethyll acetate.

IV. RESULT AND DISCUSSIONS

Various acoustical parameters compressibility (β), Inter molecular free length (Lf), Wada's constant (W), Molar sound fraction(R) and acoustic impedance (Z) were calculated using a experimental data of ultrasonic velocity and density by the equations (1-6) (14-18) discussed earlier.

In graph 1 & 2 As molar concentration increases ultrasonic velocity decreases nonlinearly its shows that inter molecular attraction takes place between the components of the mixture and the compressibility, inter molecular free length exhibits opposite trends to that velocity it is well seen in the graph plotted for concentration and various acoustical parameters in graph.1&2 for butyl acetate and ethyl acetate. Non linear decrease of R, W & Z with the increase of mole fraction indicates the solute-solvent interaction between the liquid mixtures of both systems.

V. CONCLUSION

Ultrasonic velocity investigation in Diethyl amine with Butyl acetate and Ethyl acetate shows the strong molecular interactions. The strength of the solute-solvent interaction depends on concentration, density, inter molecular free length, compressibility.

VI. REFERENCES

[1] Kannapan V. Xavier Jesu raja .S &Jeyasanthi.R, Indian J pure Applphys 41 (2003) 690.
[2] Pandharinath S, Patil V U &Hasanmehdi , J Indian Chemsoc, 78 (2002) 368.
[3] Palaniappan L and Karthikeyan V, Indian J Phys., 2005 , 79 (2),155.
[4] Piemental G C and Maclellan AL, The hydrogen bond (WH Freeman and Co, San Fransisco), 1960.
[5] Samuel Ebinezer B and Palaniappan L, J Phy Sci., 2007, 18(1),11-21.
[6] S.Prakash and J D Pandey ,J.Sci. Indus. Res. 21B, (1962) 593.
[7] B Jacobson, Acta chem., Scand, 6, (1952), 1485.
[8] M Rama Rao, J. Chem. Phys.9, (1941)682.
[9] M Rama Rao, Indian J. Chem. Phys.14, (1940)109.
[10] M Rama Rao, current sciences.8, (1939)510.
[11] Y.wada, J. Phys.Soc. Japan.4 (1949)280.
[12] RT Beyer and S V Latcher , Physical ultrasonics, Academic press, N Y (1969).
[13] R. Baskaran and T.R. Kubendran., refractive indices, ultrasonic velocities, surface tension and thermo acoustical parameters of anisaldehyde +benzene at 313.15K.,

© 2019 IJSRCSEIT | Volume 4 | Issue 9 | ISSN : 2456-3307

International journal of applied science and engineering ., 2007.

[14] C.Shanmugapriya, S.Nithya, G.velraj A.N. Kanappan ., Molecular interaction studies in liquid mixture using ultrasonic technique., International Journal of advanced Science and technology ., Vol 18.,May2010.

[15] Subramaniyan Naidu P &Ravindra Prasad K, Indian J Pure &ApplPhys 42(2004)512.

[16] EzhilPavai R, Vasantharani P &ApplPhys, 42 (2004) 934.

[17] Ali A, Nain A K Chand D &LalB,Indian J Chem A,44 (2005)511.

[18] Nikam P S ,Mehdi Hasan, Pawar T B &Sawant A B, Indian J Pure &ApplPhys, 42 (2004)172.