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Thermoacoustic investigation of organic liquid mixtures 1-chlorobutane with aromatic hydrocarbon at temperatures 303K and 313K

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ABSTRACT

Speed of sound and densities of binary mixtures of 1-chlorobutane with tolune have been carried out at 303 K and 313K. Using the measured values of ultrasonic velocity and density acoustical parameters and their excess values, excess adiabatic compressibility (β_{ad}^{E}), excess volume (V_a^E) and excess ultrasonic velocity (U^E) are evaluated. From the properties of these excess parameters the nature and strength of the interactions in these binary systems are discussed.

Keywords: Ultrasonic velocity, Thermocoustical parameters, Binary mixtures.

INTRODUCTION

Liquid and liquid mixtures have been found wide application in chemical, textile, leather and nuclear industries. It is essential to understanding of thermodynamics and transport properties of liquid and its mixtures for their applications. Ultrasonic technique has become a powerful tool for studying the molecular behavior of liquid mixtures, this is because of its ability of characterizing physicochemical behavior of liquid medium. The measurement of ultrasonic velocity having been adequately employed in understanding the molecular interactions in liquid mixtures. Molecular interaction studies can be carried out by both spectroscopic and non spectroscopic techniques. However, ultrasonic velocity and density measurements have been widely used in the field of interactions and structural aspect evaluation studies.

MATERIALS AND METHODS

Experimental

Ultrasonic interferometer model F-81 of fixed frequency 2 MHz having accuracy ±.03% and hydrostatic plunger method having accuracy ±.05% were used for measurement of ultrasonic

velocity and density of pure 1-chlorobutane and toluene and its solution of different mole concentrations at temperatures 303K and 313K. The calibration of the apparatus was done with air and deionizer double-distilled water.

RESULTS AND DISCUSSION

The values of excess adiabatic compressibility **(** β_{ad}^{E}), excess volume (V_a^E), excess ultrasonic velocity (U^E) have been calculated using following formulae.

$$\beta_{ad} = \frac{1}{u^2 \rho} \quad (1)$$

$$\beta_{ad}^{E} = \beta_{(Expt)} - \beta_{(Ideal)} \quad (2)$$

$$V_a^E = V_{(Expt)} - V_{(Ideeal)} \quad (3)$$

$$U^E = U_{(Expt)} - U_{(Ideeal)} \quad (4)$$

Table-1: Excess adiabatic compressibility (β_a^E **), excess molar volume (** V_a^E **), excess ultrasonic velocity (** U^E **) and at temperatures 303K & 313K**

Mole Conc.x	303K			313K		
	β_a^E	V_a^E	U^E	β_a^E	V_a^E	U^E
0.1	-3.59E-12	-1.75	5.382	-3.90E-12	-1.89	4.052
0.2	-5.16E-12	-2.29	7.854	-5.72E-12	-2.57	6.124
0.3	-5.45E-12	-2.01	8.456	-5.90E-12	-2.16	6.266
0.4	-4.93E-12	-1.2	7.738	-5.28E-12	-1.23	5.658
0.5	-4.32E-12	-0.5	6.990	-4.64E-12	-0.58	4.980
0.6	-3.23E-12	-0.49	5.942	-3.30E-12	-0.72	4.102
0.7	-3.56E-12	-0.84	5.314	-3.67E-12	-0.6	3.514
0.8	-2.88E-12	-0.99	4.486	-2.99E-12	-0.91	2.856
0.9	-1.56E-12	-0.42	3.218	-1.57E-12	-0.39	1718

Figure 1: Excess adiabatic compressibility (β_a^E **) verses mole fraction x**

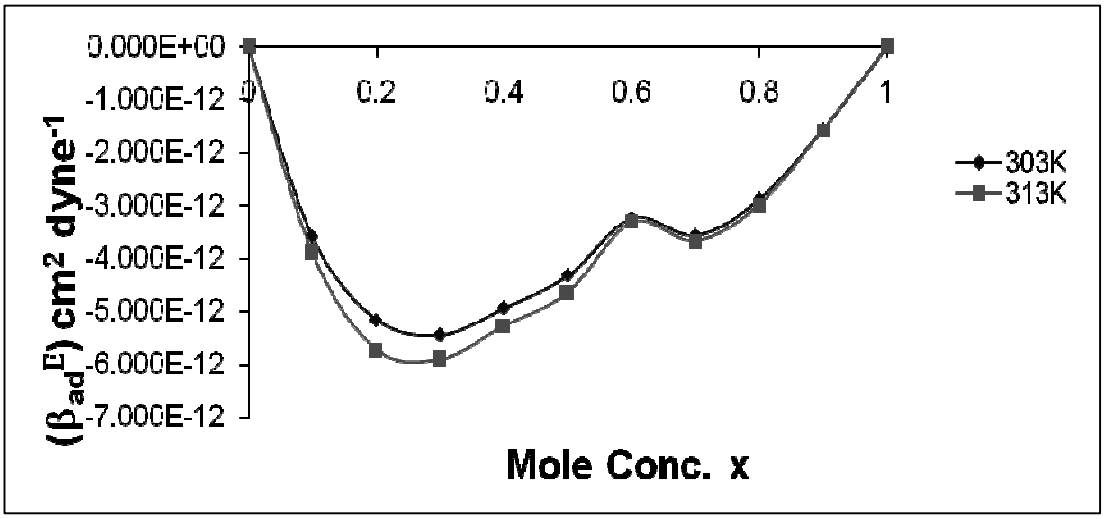

Figure 2: Excess molar volume (V_a^E) verses mole fraction x

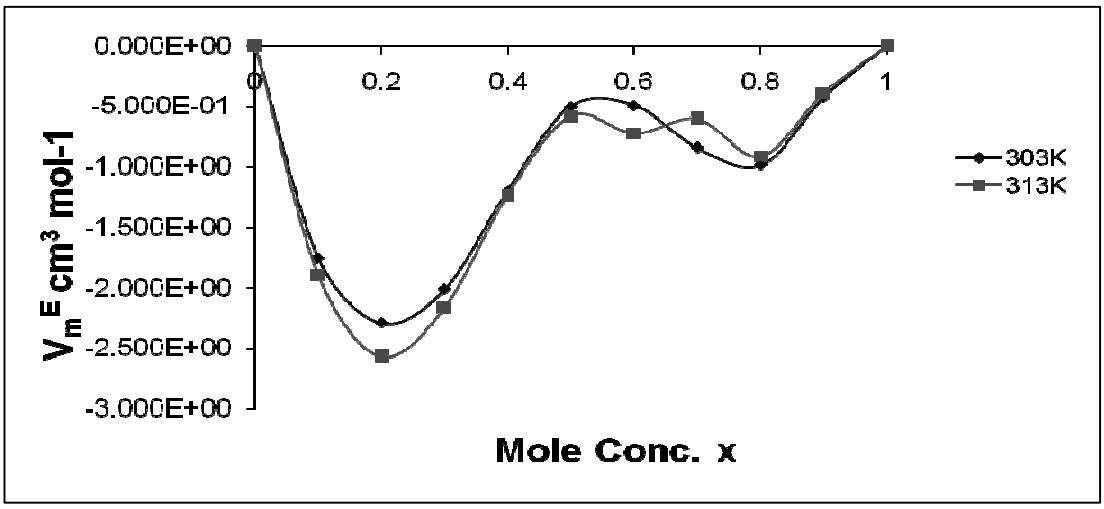

Figure 3: Excess ultrasonic velocity (U^E) verses mole fraction x

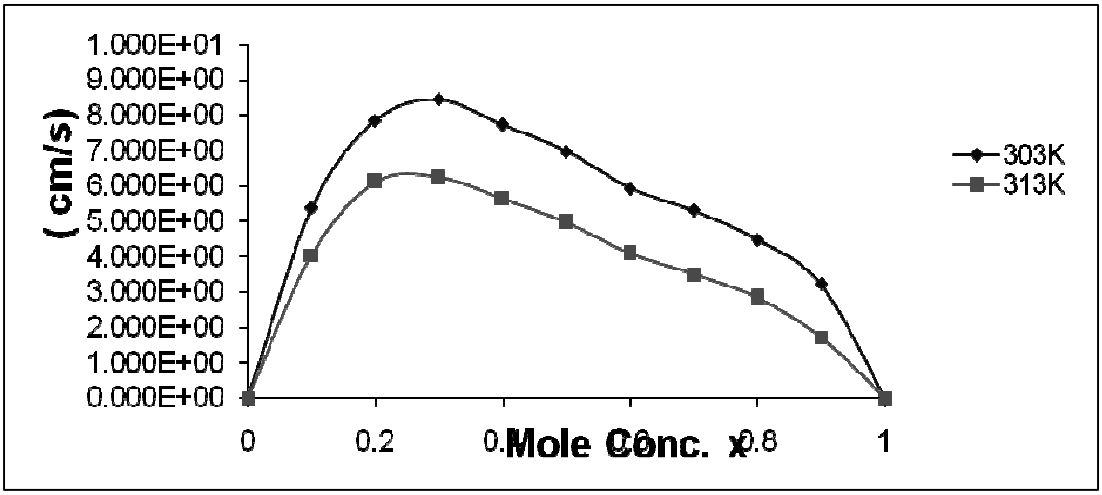

Figure 1 and 2 show the variation of excess adiabatic compressibility (β_a^E), excess molar volume (V_a^E) is negative with mole concentration, there may be charge transfer taking place hence there are attractive interaction causing association between the molecules. Also in above system there are two minima at x=0.3 and x=0.7 indicate formation of two stable cluster.

Figure 3 shows the variation of excess ultrasonic velocity (U^E) with mole concentration, positive variation in excess velocity indicates that there is more free space in the mixture.

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