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Acoustic Properties of Gasoline and Its Binary Liquid Mixtures with Kerosene

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ABSTRACT

Densities and ultrasonic speed of liquids Gasoline and Kerosene were taken in different volume concentrations from 5%, 10%, and 95% at different temperatures 298.15K to 303.15K having difference of 5K. Using this data excess parameters of excess adiabatic compressibility (β_a^E), excess molar volume (V_a^E) and excess free length (L_f^E) has been calculated. These parameters are used to discuss the molecular interactions between the component molecules and the excess functions are found to be sensitive to the nature and extent of the interactions taking place in these binary mixtures.

Keywords: Ultrasonic Parameters, Molecular Interaction And Binary Liquid Mixtures.

I. INTRODUCTION

Knowledge of acoustic properties reveals the presence of molecular interactions between the component molecules in the multi-component liquid systems. This intermolecular interaction plays an important role in the development of molecular sciences. A large number of studies have been made on the molecular interaction in liquid systems by various physical methods like Dielectric constant[1-3], Infrared, Raman effect, ultra violet and ultrasonic method[4-10]. In recent years ultrasonic technique has become a powerful tool in providing information regarding the molecular behaviour of liquids and solids owing to its ability of characterizing physiochemical behaviour of the medium. The present investigation deals with the study of molecular interaction in binary liquid mixtures. A survey of literature[11-21] indicates that adiabatic compressibility, free length and molar volume and there excess values are useful in understanding the intermolecular interactions between the molecules in binary mixtures.

II. EXPERIMENTAL

Ultrasonic interferometer model F-81 of fixed frequency 2 MHz having accuracy $\pm$ .03% and hydrostatic plunger method having accuracy $\pm$ .05% were used for measurement of ultrasonic velocity and density of different percentage of volume concentration of kerosene from 5%, 10%,-----,95% in gasoline at different temperatures. The calibration of the apparatus was done with air and deionizer double-distilled water.

III. RESULT AND DISCUSSION

The values of excess adiabatic compressibility (β_{ad}^E), excess volume (V_a^E), excess free length (L_f^E) and ultrasonic velocity using different theories have been calculated using following formulae.[11-21]

$$V = \frac{M}{\rho}$$

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

$$L_f = K \times \beta^{1/2}$$

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

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

$$L_f^E = L_{f\,(Expt)} \_ L_{f\,(Ideal)}$$

Table 1. Excess Adiabatic Compressibility ($\beta_{ad}{}^{E}$) $cm^2\,dyne^{-1}$

x %	298.15K	303.15K	308.15K	313.15K	318.15K
5	-4.65E-13	-5.96E-13	-6.38E-13	-7.02E-13	-7.77E-13
10	-7.22E-13	-8.73E-13	-9.29E-13	-1.03E-12	-1.13E-12
15	-9.46E-13	-1.11E-12	-1.18E-12	-1.31E-12	-1.43E-12
20	-1.14E-12	-1.32E-12	-1.40E-12	-1.56E-12	-1.70E-12
25	-1.30E-12	-1.49E-12	-1.57E-12	-1.76E-12	-1.91E-12
30	-1.42E-12	-1.63E-12	-1.71E-12	-1.92E-12	-2.09E-12
35	-1.52E-12	-1.74E-12	-1.82E-12	-2.05E-12	-2.23E-12
40	-1.59E-12	-1.81E-12	-1.89E-12	-2.14E-12	-2.32E-12
45	-1.63E-12	-1.86E-12	-1.93E-12	-2.19E-12	-2.38E-12
50	-1.64E-12	-1.87E-12	-1.94E-12	-2.21E-12	-2.40E-12
55	-1.62E-12	-1.86E-12	-1.91E-12	-2.19E-12	-2.38E-12
60	-1.58E-12	-1.81E-12	-1.86E-12	-2.14E-12	-2.33E-12
65	-1.51E-12	-1.74E-12	-1.77E-12	-2.06E-12	-2.24E-12
70	-1.42E-12	-1.64E-12	-1.66E-12	-1.94E-12	-2.11E-12
75	-1.30E-12	-1.52E-12	-1.51E-12	-1.80E-12	-1.96E-12
80	-1.15E-12	-1.37E-12	-1.34E-12	-1.62E-12	-1.77E-12
85	-9.86E-13	-1.19E-12	-1.14E-12	-1.42E-12	-1.55E-12
90	-7.96E-13	-9.93E-13	-9.19E-13	-1.19E-12	-1.30E-12
95	-5.82E-13	-7.69E-13	-6.68E-13	-9.24E-13	-1.02E-12

Table 2. Excess Volume (V^E) $cm^3\,mol^{-1}$

x %	298.15K	303.15K	308.15K	313.15K	318.15K
5	1.281E+00	1.194E+00	1.277E+00	1.241E+00	1.293E+00
10	2.384E+00	2.301E+00	2.416E+00	2.369E+00	2.442E+00
15	3.190E+00	3.105E+00	3.249E+00	3.186E+00	3.274E+00
20	3.757E+00	3.668E+00	3.836E+00	3.754E+00	3.853E+00
25	4.130E+00	4.032E+00	4.223E+00	4.119E+00	4.225E+00
30	4.344E+00	4.235E+00	4.445E+00	4.319E+00	4.427E+00
35	4.425E+00	4.303E+00	4.531E+00	4.380E+00	4.489E+00
40	4.395E+00	4.258E+00	4.503E+00	4.326E+00	4.433E+00

45	4.271E+00	4.119E+00	4.378E+00	4.174E+00	4.278E+00
50	4.068E+00	3.898E+00	4.172E+00	3.940E+00	4.039E+00
55	3.797E+00	3.609E+00	3.895E+00	3.636E+00	3.728E+00
60	3.467E+00	3.261E+00	3.559E+00	3.271E+00	3.356E+00
65	3.088E+00	2.863E+00	3.172E+00	2.855E+00	2.931E+00
70	2.666E+00	2.421E+00	2.740E+00	2.394E+00	2.461E+00
75	2.205E+00	1.940E+00	2.269E+00	1.895E+00	1.952E+00
80	1.713E+00	1.427E+00	1.765E+00	1.362E+00	1.408E+00
85	1.192E+00	8.858E-01	1.232E+00	8.000E-01	8.355E-01
90	6.459E-01	3.194E-01	6.733E-01	2.128E-01	2.370E-01
95	7.863E-02	-2.686E-01	9.274E-02	-3.964E-01	-3.839E-01

Table 3. Excess Free Length (L_f^E) cm

x %	298.15K	303.15K	308.15K	313.15K	318.15K
5	5.595E-11	5.584E-11	5.786E-11	5.703E-11	5.687E-11
10	1.013E-10	1.028E-10	1.072E-10	1.081E-10	1.106E-10
15	1.344E-10	1.369E-10	1.432E-10	1.452E-10	1.497E-10
20	1.577E-10	1.609E-10	1.684E-10	1.711E-10	1.770E-10
25	1.730E-10	1.766E-10	1.850E-10	1.880E-10	1.949E-10
30	1.817E-10	1.855E-10	1.945E-10	1.975E-10	2.050E-10
35	1.851E-10	1.889E-10	1.981E-10	2.009E-10	2.088E-10
40	1.840E-10	1.875E-10	1.968E-10	1.991E-10	2.072E-10
45	1.790E-10	1.823E-10	1.914E-10	1.931E-10	2.011E-10
50	1.709E-10	1.737E-10	1.825E-10	1.836E-10	1.913E-10
55	1.601E-10	1.623E-10	1.707E-10	1.709E-10	1.782E-10
60	1.470E-10	1.486E-10	1.564E-10	1.557E-10	1.625E-10
65	1.320E-10	1.328E-10	1.400E-10	1.383E-10	1.445E-10
70	1.152E-10	1.153E-10	1.218E-10	1.190E-10	1.245E-10
75	9.701E-11	9.631E-11	1.020E-10	9.807E-11	1.028E-10
80	7.757E-11	7.603E-11	8.083E-11	7.577E-11	7.966E-11
85	5.707E-11	5.464E-11	5.854E-11	5.229E-11	5.530E-11
90	3.565E-11	3.230E-11	3.527E-11	2.778E-11	2.987E-11
95	1.343E-11	9.158E-12	1.116E-11	2.411E-12	3.528E-12

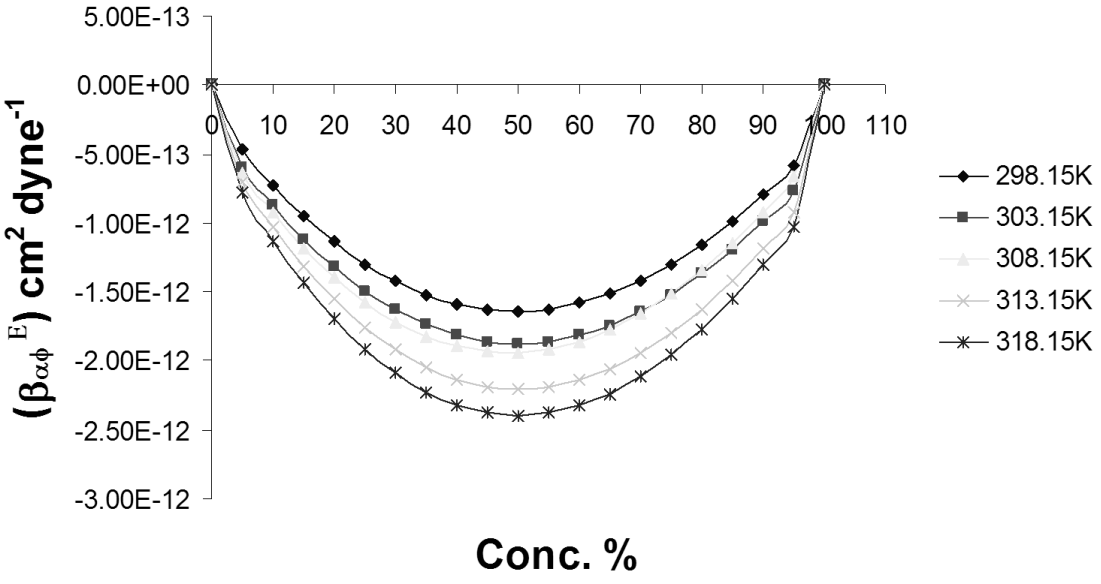

Figure 1. Volume conc. x % versus $\beta_{ad\,E}$

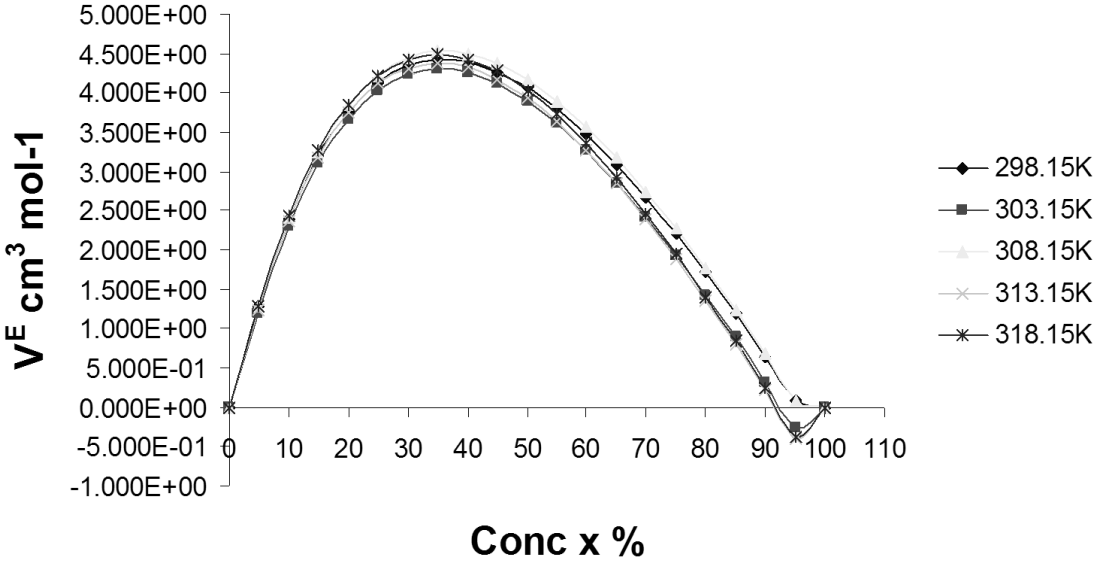

Figure 2. Volume conc. x % versus V^E

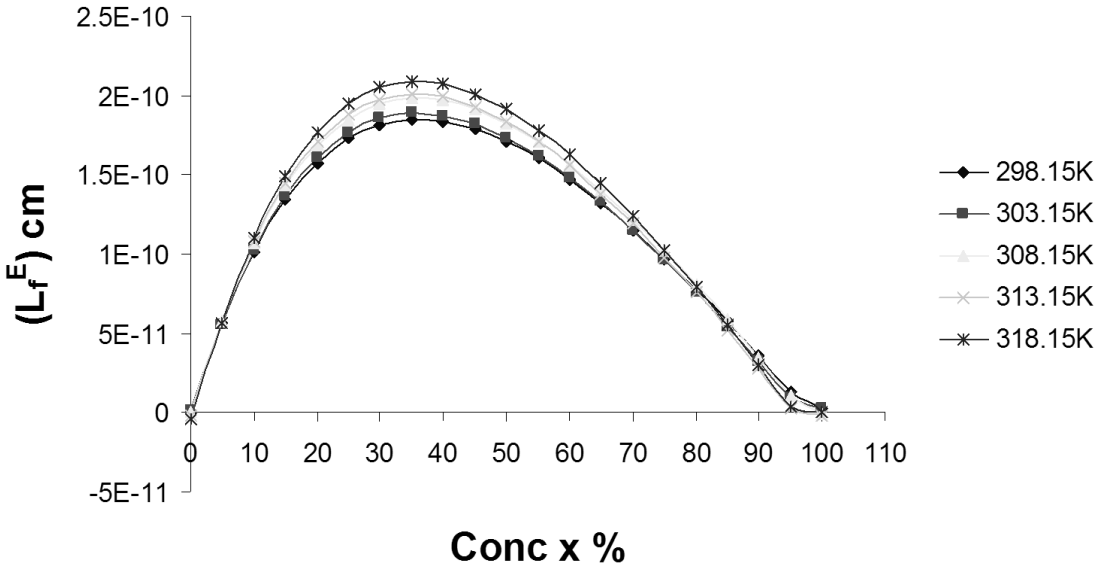

Figure 3. Volume conc. x % versus L_f^E

Figure 1 and 2 reveals the variation of excess adiabatic compressibility (β_{ad}^{E}) and excess volume (V^E) with percentage volume of mixture at five different temperatures. The smooth variation of β_{ad}^{E} but it is negative and there is small change in maxima which obtained at 50% with temperature, the variation of V^E also smooth but it is positive and there is small change in maxima with temperature which obtained at 35%. In this system negative β_{ad}^{E} and positive V^E indicated an attractive interaction between two component liquid molecules in the mixture leading to an association between them. Fig. 3 reveals the smooth variation of Liquids, 42 (2004). with L_f^E. The positive variation of L_f^E exhib

IV. CONCLUSION

In the study binary system of Gasoline + Kerosene there was larger value of V^E as well as β_{ad}^E. indicated an attractive interaction between two component liquid molecules in the mixture leading to an association between them.

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