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THE STUDY OF MOLECULAR INTERACTION OF BENZALDEHYDE IN NON-POLAR AND POLAR SOLVENTS AT 303K

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ABSTRACT
Ultrasound velocity density and viscosity in a binary mixture of Benzaldehyde in polar and non-polar solvents have been determined at 303K over the entire composition range. With the help of experimental determination ultrasound velocity , density and viscosity the various acoustic and thermodynamic parameters i.e isentropie compressibility (β_s), Intermolecular free length (L_f) ,specific acoustic impedance (Z) , molar volume (Vm) ,available volume (Va) and other constant parameter computed.The excess value of for said parameters will conclude the nature and extent of molecular interaction between like and unlike molecules.
Keywords: Ultrasonic interferometer, Ostwald viscometer , pyknometer ,liquid benzaldehyde, Acetone.

INTRODUCTION

Ultrasound velocity device is the latest technique by which molecular interaction determination is more accurate so ultrasonic waves beyond 2 MHz frequency physically change are only possible. So it is adopted as modern technique.

Prakash[1-2] reported ultrasound velocity, density, excess molar volume, excess isentropic compressibility and some other parameters in various binary systems. The value of the excess molar volume of this system was good agreement with Battino[3].

Several workers[4-6] have been calculated physical properties and various acoustic and thermodynamic parameters in pure organic solvents

Many co-workers[7-11] observed ultrasound velocity ,density, density and a related parameter of ternary liquid mixtures. Palani reported the result of an ultrasonic study of molecular interaction in some ternary liquid mixture.Benzene- ethyl alc- Chlorobenzene,Benzene-ethyl alc- Bromobenzene Benzene- ethyl alc- Acetophenone.

Saxena and Singh[12] have studied the ternary liquid mixtures of butyl acetate, ethyl acetate, phenol and n-butyl alc. In CCl4 using the dielectric technique at micro frequencies.

EXPERIMENTAL

Ultrasound Velocity

Ultrasound velocity is measured by the ultrasonic interferometer. It has the accuracy of about ±0.05%

Density ($\dot{\rho}$)

The density is measured with the help of pyknometer.

Formula used

$$\dot{\rho} = \frac{m}{V + r^2(h_1 + h_2)} \quad (1)$$

Where,
m is the weight of the liquid filled in pyknometer used
r is the radius of capillaries

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h_1 and h_2 are the height of the liquid in the capillaries.

Viscosity

It is measured with the help of Ostwald viscometer. On the basis of eyring theory, Gurnberg had given an equation for the determination of viscometer of liquid and liquid mixture, which is given below

$$\eta = \dot{\rho}\left(at - \frac{b}{t}\right) \quad (2)$$

Where,
η is the viscosity of liquid
ρ̇ is the density of liquid
t is the time flow of the liquid
a and b are viscometric constants

Isentropic Compressibility

It is calculated by the formula-

$$\beta_s = \frac{1}{v^2\dot{\rho}} \quad (3)$$

Intermolecular Free Length

The distance between the surface of two neighboring molecules is called intermolecular free length . Erying said that sound wave in liquid travels with the infinite velocity within the molecules.

$$L_f = \frac{2V_a}{Y} \quad (4)$$

Specific Acoustic Impedance(Z)

It is calculated by this formula-

$$Z = V.\dot{\rho} \times 10^{-5} \quad (5)$$

Molar Volume (V_m)

It is calculated by the formula-

$$V_m = \frac{\overline{M}}{\dot{\rho}} \text{ ; Where } \overline{M} = (m_1x_1 + m_2x_2) \quad (6)$$

Available Volume (V_a)

$$V_a = V_m\left(1 - \frac{V_t}{V_\infty}\right) \quad (7)$$

Where
V_m= molar volume; V_t= ultrasound velocity at given temp ; V_∞=1600 m/sec

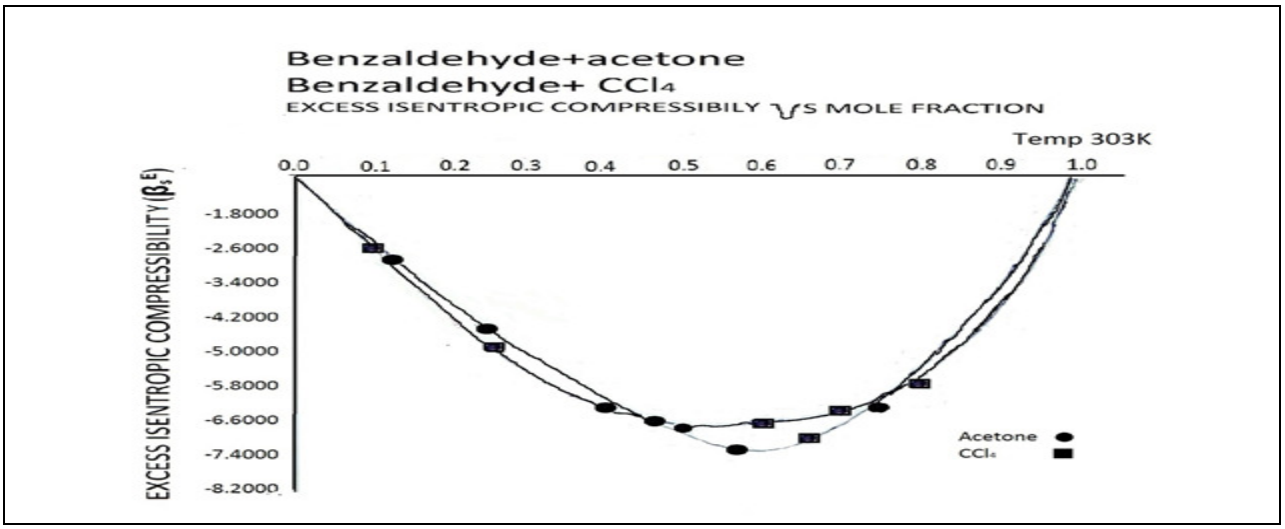

Fig.-1

Table-1: Benzaldehyde + Acetone at temperature 303K

MOLE FRACTION OF C_6H_5CHO	U.V	ρ	η	β_s	L_f	V_m	V_a
1.0000	1420	1.0375	1.2165	47.8838	0.4366	102.34	11.5139
0.8682	1384	1.0141	1.1972	51.4810	0.4527	98.28	13.2688
0.7449	1352	0.9878	1.1525	55.3831	0.4695	94.91	14.7115
0.6230	1328	0.9615	1.1225	58.9371	0.4845	91.77	15.6014
0.5277	1296	0.9352	0.9065	63.6627	0.5034	89010	16.9296
0.4217	1272	0.9089	0.8110	68.0001	0.5203	86.08	17.6471
0.3271	1248	0.8826	0.7532	72.7456	0.5381	83.50	18.3709
0.2381	1224	0.8560	0.6866	77.7764	0.5561	81.10	19.0604
0.1196	1198	0.8247	0.5507	84.4870	0.5799	77.28	19.4190
0.0785	1176	0.8095	0.4541	89.3240	0.5963	76.30	20.3664
0.0000	1160	0.7774	0.3153	95.5959	0.6169	74.60	20.5170

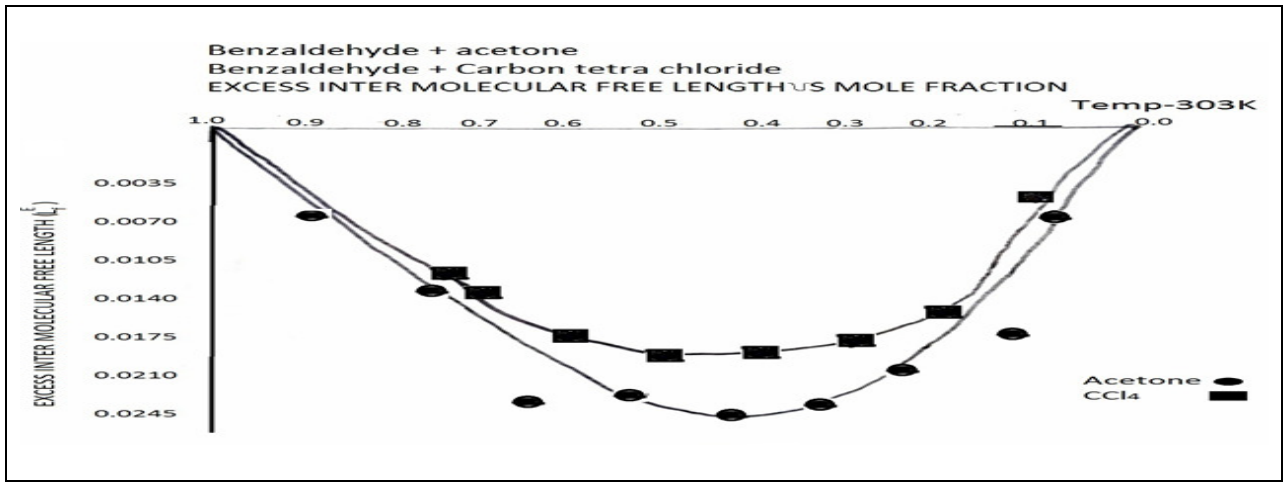

Fig.-2

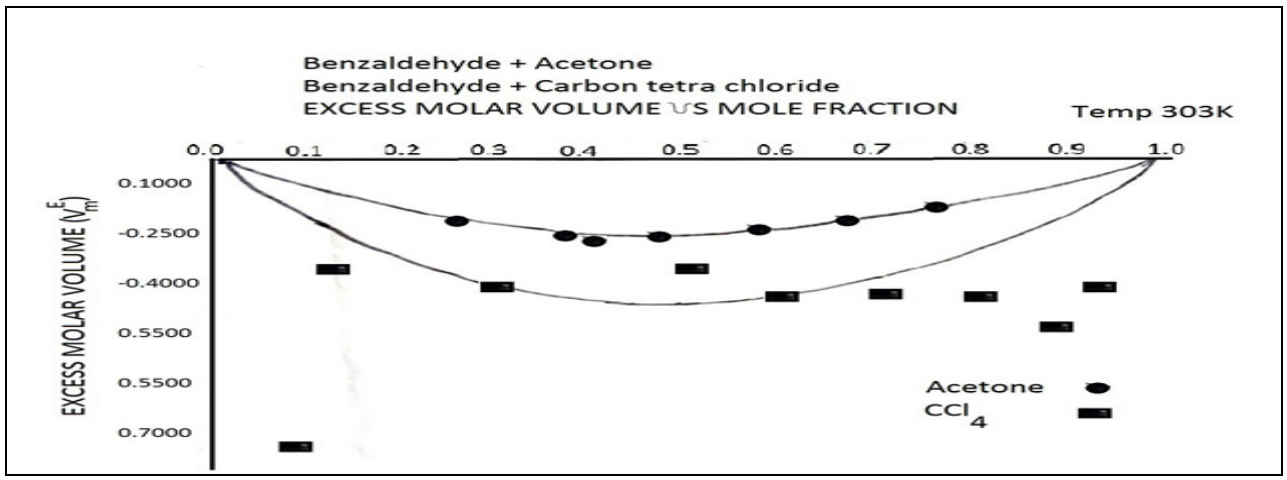

Fig.-3

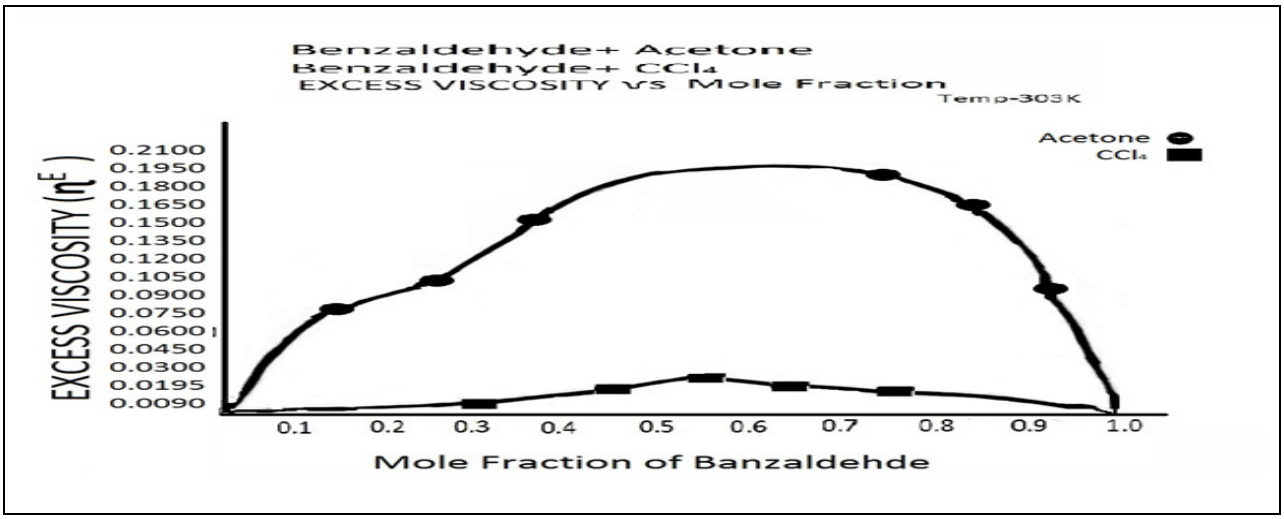

Fig.-4

Table-2: Benzaldehyde + CCl_4 at temperature 303K

MOLE FRACTION OF C_6H_5CHO	U.V	ρ	η	B_s	L_f	V_m	V_a
1.0000	1420	1.0357	1.2165	47.8838	0.4366	102.34	11.5139
0.8988	1365	1.1117	1.1952	48.2770	0.4384	99.71	14.6462
0.7461	1294	1.1769	1.1596	50.7448	0.4494	100.42	19.2057
0.6978	1268	1.1985	1.1494	51.8947	0.4545	100.54	20.8635
0.5962	1224	1.2459	1.1261	54.0659	0.4656	100.63	23.6494
0.4962	1174	1.2997	1.0994	55.8239	0.4717	100.16	26.6635
0.3961	1118	1.3545	1.0726	59.0659	0.4849	99.65	30.0220
0.2968	1070	1.4857	1.0480	62.1355	0.4973	99.41	32.9326
0.1972	1022	1.4577	1.0225	65.6795	0.5113	99.15	35.8187
0.0985	962	1.5095	0.9972	71.5841	0.5338	98.86	39.2217
0.0000	918	1.5435	0.9694	76.8790	0.5532	97.77	42.5283

RESULTS AND DISCUSSION

We have measured ultrasound velocity, density and sound velocity of benzaldehyde in acetone and carbon tetrachloride at 303K .The other acoustic and thermodynamic parameters β_s ,L_f ,z ,V_m ,V_a and ζ were computed at a variable mole fraction of benzaldehyde . The result tabulated on the tables 1, 2 . The excess values of β_s^E ,L_f^E ,V_m^E and η^E are plotted on the graphs (fig 1,2,3,4) at a variable mole fraction of benzaldehyde at 303K . The comparative lines of graphs of benzaldehyde in acetone and carbon tetrachloride concluded the nature and extent of interaction between polar and non-polar molecules. Benzaldehyde is aromatic aldehyde compound having Benzene ring and –CHO group on it. Therefore it is active and polar towards other molecules. When it mixed with acetone and CCl_4 being polar and non-polar molecules respectively. Acetone is a polar molecule so it interacts with benzaldehyde with more extent which shown by the curved line on figures, while less extent in CCl_4 . It is shown in figure-1 that peak of the graph of β_s^E is at -7.50 while in CCl_4 at -6.40 at a mole fraction of benzaldehyde 0.52. The other excess values also support the facts.

Therefore it is concluded that there is specific interaction in both binary systems, but extent of interaction in benzaldehyde + acetone is more comparative to Benzaldehyde+CCl_4 binary system

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