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Study of intermolecular interaction in binary mixtures of paraanisaldehyde with bromobenzene, ethylbenzene and nitrobenzene at 308.15K

Golamari Siva Reddy[1], Ronda Srinivasa Reddy[2*], Mallu Maheswara Reddy[2] and T. R. Kubendran[3]

[1]Department of Petroleum Engineering, Department of Biotechnology, K L University, Vaddeswaram, Guntur
[2]Centre of Bioprocess Technology, Department of Biotechnology, K L University, Vaddeswaram, Guntur
[3]Department of Chemical Engineering, Anna University, Chennai, India

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ABSTRACT

The ultrasonic velocity, density and viscosity at 308.15K have been measured in the double frameworks of Paraanisaldehyde with Bromobenzene, Ethyl benzene and Nitrobenzene. From the test information different acoustical parameters, for example, as adiabatic compressibility (β), free volume (V_f), Shear relaxation time (τ), free length (L_f) and acoustical impedance (Z) ere ascertain. The results are deciphered regarding sub-atomic association between the segments of the mixture

Keywords: Ultrasonic velocity, Acoustical properties, Molecular interaction.

INTRODUCTION

Ultrasonic is a flexible non-ruinous method and exceedingly helpful for examination of different physico-compound properties, for example, adiabatic compressibility, intermolecular free length, free volume and Shear relaxation time at 308.15K. Late advancements have discovered utilization of ultrasonic vitality in medication, building and farming [1-4].

The investigation of atomic connection assumes an indispensable part in the improvement of sub-atomic science. Sub-atomic associations and structural conduct of sub-atomic and their mixtures might be distinguished utilizing ultrasonic studies. Ultrasonic waves have been utilized by numerous researchers to explore the way of sub-atomic cooperation and physico-concoction conduct of immaculate, paired and ternary fluid mixtures [5-8].

Ultrasonic speed together with thickness and consistency information outfit abundance of data about the association between particles, dipoles, hydrogen holding, multi-polar and dispersive powers [9-12]. Anisaldehyde atom is very polar and self related through hydrogen holding of their amine bunch. In the present work an endeavour has been made to explore the conduct of twofold results of Paraanisaldehyde with Bromobenzene, Ethylbenzene and Nitrobenzene as to adiabatic compressibility, intermolecular free length and particular acoustic impedance from ultrasonic estimations at 313.15 K.

MATERIALS AND METHODS

The chemicals used were of analytical grade and obtained from lobo chemicals. All the Components were dried over anhydrous potassium carbonate and fractionally distilled [13]. A thermostatically controlled well-stirred water bath whose temperature was controlled to ±0.01 K accuracy was used for all the measurements. All the measurements were done by using electronic balance Shimadzu Corporation Japan Type BL 2205 accurate to 0.01 g. The possible uncertainty in the mole fraction was estimated to be less than ±0.0001.

RESULTS AND DISCUSSION

Different acoustical parameters, for example, adiabatic compressibility (β), Intermolecular free length (L_f), free volume (V_f), and specific acoustical impedance (Z), were computed utilizing the trial information of ultrasonic sound velocity, density and viscosity by the following equations (1-4).

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

$$V_f = \left(\frac{M_{eff} U}{\eta k}\right)^{\frac{3}{2}} \quad (2)$$

$$L_f = KT\beta_s^{\frac{1}{2}} \quad (3)$$

$$Z = \rho u \quad (4)$$

Where KT is the temperature subordinate steady having an esteem 199.53 x 10^{-8} in MKS framework, K is the consistent equivalent to 4.28 x 10^{9} in MKS framework, autonomous of temperature of all fluids, and all the documentations having the ordinary implications.

The measured parameters viz., ultrasonic velocity (U), density (p), adiabatic compressibility (β) and viscosity (η) are given in Table -1. Table-1 demonstrates that, in every one of the three frameworks, the velocity increases with concentration of Bromobenzene, Ethyl benzene and Nitrobenzene. This demonstrates that solid connection saw at higher amassing of X. The consistency values additionally same pattern with speed in these three frameworks. Thickness diminishes in every one of the three frameworks proposing in this manner more relationship in the middle of solute and dissolvable atoms in recent frameworks.

From the same Table- 1, it is watched that adiabatic compressibility (β) expands with expansion in amassing of Bromobenzene, Ethyl benzene and Nitrobenzene. This expand structural request of paraanisaldehyde may bring about more union, and prompts a build in (β). The expand in (β) brings about a build in the estimation of (U). The free length (L_f) is an alternate parameter which is ascertained utilizing ultrasonic speed and adiabatic compressibility. It is watched that Lf, expands with the convergence of Bromobenzene, Ethyl benzene and Nitrobenzene. It has been watched that intermolecular free length builds with mole part. Build in intermolecular free length prompts positive deviation in sound speed and negative deviation in compressibility. This shows that the atoms are closer in the framework.

The figured different parameters like free volume (V_f) and shear's relaxation time (r) are given in Table-2. The variety in free volume (V_f) diminishes with increments in profound quality of Bromobenzene, Ethyl benzene and Nitrobenzene in each of the three frameworks. The free volume is the space accessible for the particle to move in a fanciful unit cell. These builds shear's relaxation time (r). The varieties in shear's relaxation time are given in the same Table-2. As expressed over the shear's relaxation time builds with increment in profound quality of Bromobenzene, Ethylbenzene and Nitrobenzene. The acoustic impedance (Z) is the result of ultrasonic speed and thickness of the result. The estimation of acoustic impedance additionally diminishes with expansion in amassing of Bromobenzene, Ethylbenzene and Nitrobenzene. Build in Lf and abatement of Z with the amassing of Bromobenzene, Ethylbenzene and Nitrobenzene; propose vicinity of dissolvable solute connections in three frameworks. The estimation of acoustic impedance (Z) is record.

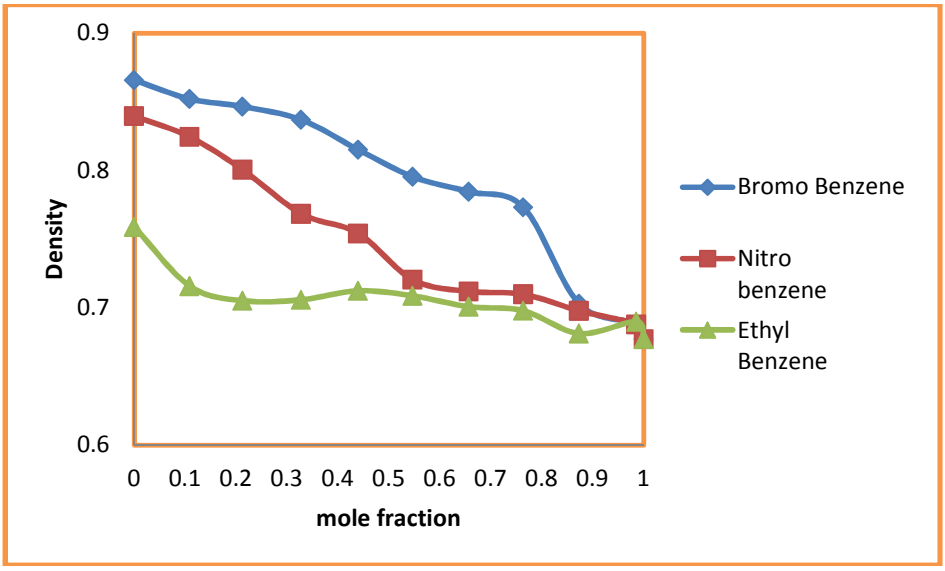

Figure 1: Mole fraction versus Density at 308.15K

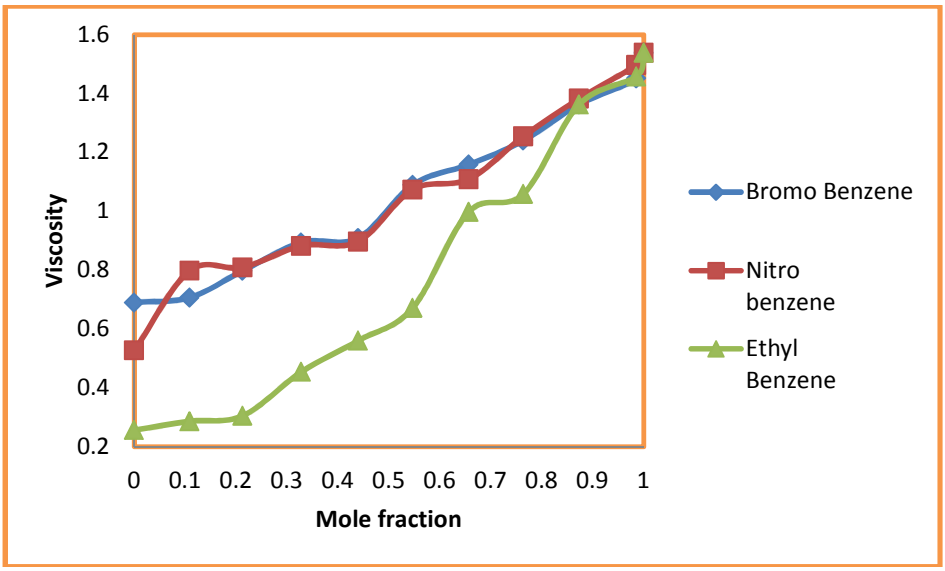

Figure 2: Mole fraction versus Viscosity at 308.15K

Table -1:- Values of ultrasonic velocity (U) and density (ρ), viscosity (η) and adiabatic compressibility (β) at 308.15K

Mole fraction of Para anisaldehyde	Ultrasonic Velocity(U) (m/sec)			Density(ρ), gm/mol			Viscosity(η),Nsm^{-2}			Adiabatic compressibility(β), m^2 N^{-1}		
X	Bromo Benzene	Nitro benzene	Ethyl Benzene	Bromo Benzene	Nitro benzene	Ethyl Benzene	Bromo Benzene	Nitro benzene	Ethyl Benzene	Bromo Benzene	Nitro benzene	Ethyl Benzene
0.00	1245.00	1258.00	1125.00	0.87	0.84	0.76	0.69	0.53	0.26	2.43	4.29	20.12
0.11	1263.00	1263.00	1139.00	0.85	0.82	0.72	0.71	0.80	0.29	2.35	1.91	17.09
0.21	1269.00	1278.00	1145.00	0.85	0.80	0.71	0.80	0.81	0.30	1.86	1.91	15.30
0.33	1272.00	1286.00	1158.00	0.84	0.77	0.71	0.89	0.88	0.45	1.50	1.67	6.88
0.44	1278.00	1298.00	1198.00	0.82	0.75	0.71	0.91	0.90	0.56	1.49	1.65	4.48
0.55	1280.00	1310.00	1228.00	0.80	0.72	0.71	1.09	1.07	0.67	1.06	1.20	3.13
0.66	1285.00	1325.00	1239.00	0.78	0.71	0.70	1.16	1.11	1.00	0.95	1.14	1.43
0.76	1296.00	1339.00	1267.00	0.77	0.71	0.70	1.24	1.25	1.06	0.84	0.90	1.28
0.87	1354.00	1349.00	1298.00	0.70	0.70	0.68	1.36	1.38	1.36	0.77	0.75	0.79
0.99	1362.00	1362.00	1355.00	0.69	0.69	0.69	1.45	1.50	1.46	0.69	0.65	0.68
1.00	1378.00	1378.00	1378.00	0.68	0.68	0.68	1.54	1.54	1.54	0.62	0.62	0.62

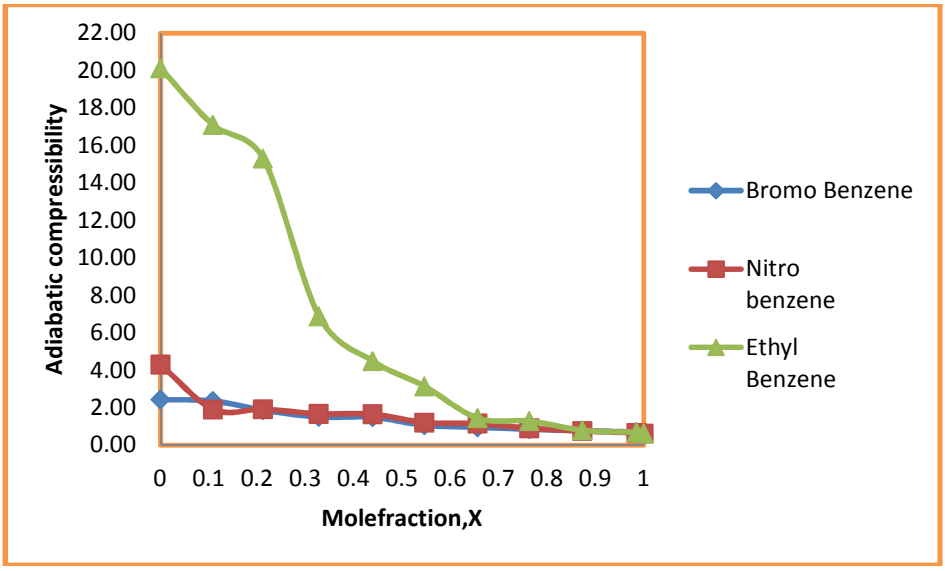

Figure 3: Mole fraction versus adiabatic compressibility at 308.15K

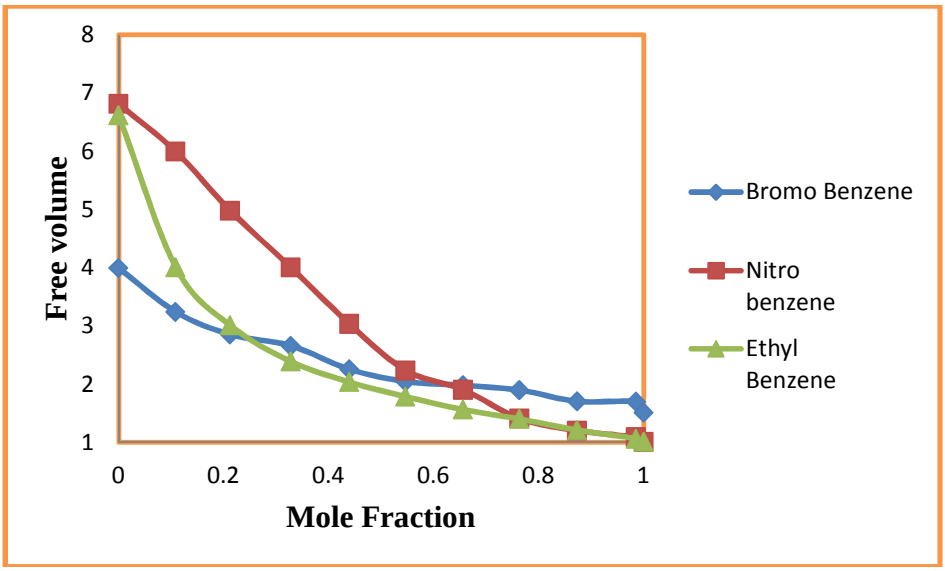

Figure 4: Mole fraction versus Free Volume at 308.15K

Table -2:- Values of free volume (V_f) and shear's relaxation time (τ), free length (L_f) and acoustical impedance (Z) at 308.15K

Mole fraction of para anisaldehyde	Free Volume(V_f) m^3 mol^{-1}			Shears relaxation time(τ)			Free length (L_f)			Acoustic impedance(Z) (Kg/ m^2.sec^{-1})		
X	Bromo Benzene	Nitro benzene	Ethyl Benzene	Bromo Benzene	Nitro benzene	Ethyl Benzene	Bromo Benzene	Nitro benzene	Ethyl Benzene	Bromo Benzene	Nitro benzene	Ethyl Benzene
0	3.99	6.81	6.61	0.72	0.53	0.47	6.90	6.90	6.90	1077.80	1056.22	853.76
0.1087	3.24	5.99	4.01	0.85	0.69	0.46	6.62	6.90	6.50	1076.20	1041.34	815.30
0.2125	2.85	4.98	3.01	0.98	0.73	0.50	6.62	6.92	6.50	1074.21	1023.04	807.34
0.3278	2.66	4.01	2.39	1.22	0.89	0.56	6.64	6.93	6.50	1064.54	988.29	817.32
0.4392	2.26	3.04	2.04	1.59	1.20	0.66	6.65	6.93	6.50	1041.83	978.95	853.46
0.5465	2.05	2.24	1.79	2.05	1.45	0.80	6.65	6.95	6.52	1018.11	943.72	870.16
0.6563	1.98	1.90	1.56	2.55	1.93	1.12	6.66	6.95	6.52	1008.08	943.27	868.29
0.7635	1.90	1.41	1.40	3.03	2.56	1.51	6.68	6.96	6.53	1002.07	950.42	884.11
0.8729	1.71	1.20	1.21	3.58	3.26	2.00	6.68	6.96	6.55	951.73	941.33	884.20
0.9854	1.70	1.09	1.07	4.05	3.97	3.25	6.70	6.97	6.59	937.74	936.78	934.81
1	1.51	1.01	1.01	4.53	4.53	4.53	6.70	6.97	6.97	933.04	933.04	933.04

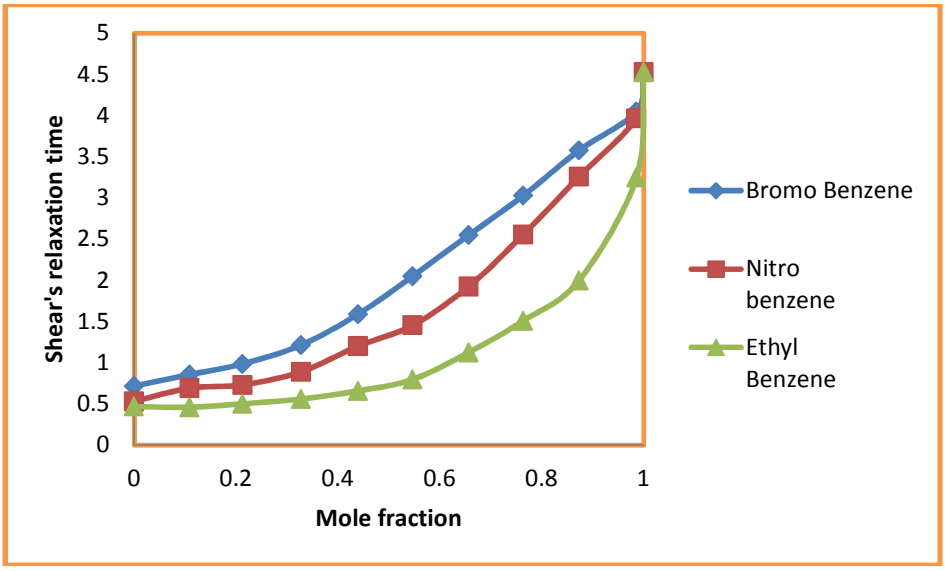

Figure 5: Mole fraction versus Shear relaxation time at 308.15K

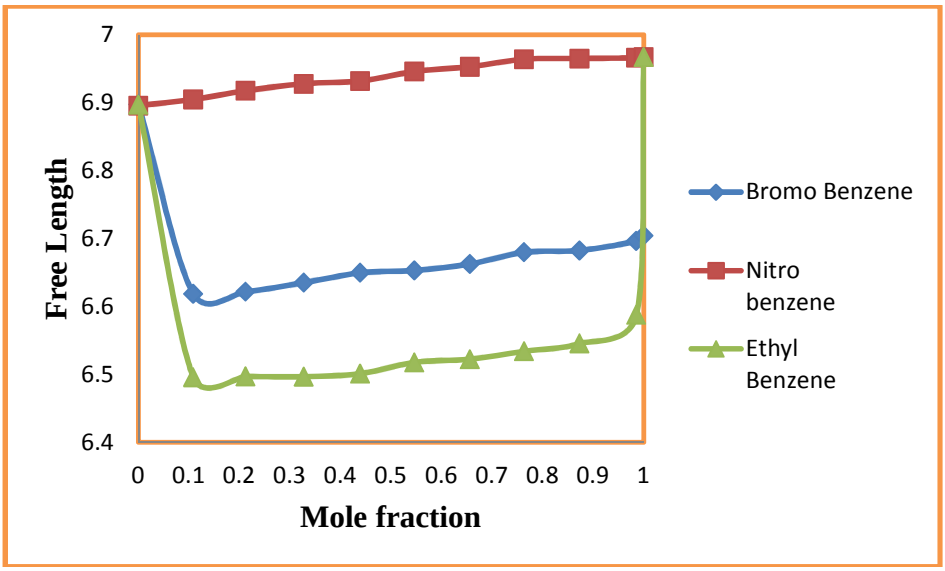

Figure 6: Mole fraction versus Free length at 308.15K

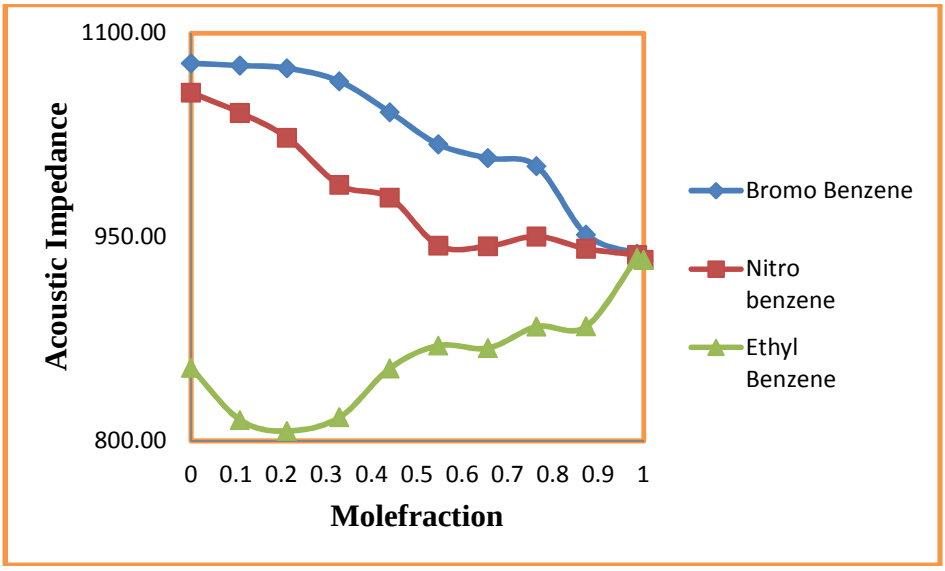

Figure 7: Mole fraction versus Acoustic impedance (Z) at 308.15K

CONCLUSION

The ultrasonic velocity, density, viscosity and other related parameters were calculated. The observed increase of ultrasonic velocity indicates the solute-solvent interaction. The existence of type of molecular interaction is solute-solvent is favoured in all these three systems, confirmed from the Z, U and η *etc*., the existence of solute-solvent interaction is in the order: Nitrobenzene>Ethylbenzene>Bromobenzene.

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