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Ultrasonic Studies of Isoamylalcohol with Equimolar Mixture of Ethanol and Formamide

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Abstract*— The binary mixtures of Ethanol and Formamide with Isoamylalchohol containing different ultrasonic properties.The ultrasonic related physicalparameters like velocity (U), density (ρ), adiabatic compressibility (βad), intermolecular free length(Lf), acoustic impedance (Z).The result is interpreted in terms of molecular interaction such as dipole-dipole interaction through hydrogen bonding between components of mixtures. The dependence ofexcess properties of mixture compositions were compared and discuss in terms of the intermolecularfree length and other factors affecting the salvation and self association effect. The excess values of these indicated pole-induced dipole inter action complexity in the binary liquid mixture.

Index Terms*— Ultrasonic Velocities; Thermodynamic Parameters; Acoustic Impedance; IntermolecularFree Length.

I. PROPERTIES OF THE CHEMICALS USED

Ethanol (C2H6O) is a highly impulsive, monochrome, flammable liquid. Whose molecular weight is 46.07 g/mol and density is 0.789 g/cc. It is also known as ethyl alcohol, grain alcohol, pure alcohol and drinking alcohol. Basically it is simply as alcohol which has a strong characteristic of odor. Ethanol has a refractive index of 1.3614at 250C and is a functional solvent, many organic solvents, aliphatic chlorides. Miscible with water and light aliphatic hydrocarbons. it has hydrophilic (OH) group which helps in many ways. The short hydrophobic hydrocarbon chain CH3CH2 can attract non polar molecules. So ethanol can liquefy both polar and non-polar substances. Ethanol has a neutral molecule characteristics and the pH of a solution in water is nearly 7. It has wide use as a solvent of substances proposed for human contact or utilization, flavorings, colorings, including scents, medicines as a fuel for internal combustion engines.

Formamide CH3NO is a clear liquid with Ammonia-like odor and miscible with water. Which has a molecular weight 45.04 g/mol and density 1.1209 g/cc at 350◦C .It is also known as methanamide and carbamaldehyde. It melts @ 250C andBoils @ 210◦C. It is widely used as a synthesizing vitamin, as a softener for paper and fiber solvent for industrialized sulfate drugs. Form amide type organic compound molecules square measure extremely polar and square measure powerfully self associated through intensive 3 - dimensional web work of element bonds, through its 3 bond donors (3H. atoms) and 3 acceptors (two lone pairs of electrons at gas and one on atomic number 7 atom)[1-5]

Isoamylalcohol C5H12O is a colorless liquid which has particular characteristic odor. Whose molecular weight is 88.20 g/mol and density is 0.8005 g/cc at 350C.lts viscosity is 4.3 cp at 200C and melting and boiling flecks are 156 K and 404 K respectively. It is useful in milk testing and as a solvent, paint stripper intermediate in pharmaceutical and photographic industry. Secondary alcohol molecules are polar and self-associated through hydrogen bonding of their hydroxyl group[6-8].

II. EXPERIMENTAL WORK

The chemicals ethanol-absolute (mass fraction purity 99.9%) (Changshu Yang Yuan Chemicals-China make) and form amide (mass fraction purity 99%), isoamyl alcohol (mass fraction purity 99%) used in Guaranteed Reagent grade obtained from LOBA Chemicals, INDIA. The purity of the liquids were tartan by aligning their ultrasonic speeds and densities at 308.15 K and we have in good concurrence With literature values[9,10] and are shown in Table. The equimolar mixture of ethanol and formamide (EMM) is taken first and which is later used to prepare the liquid mixtures with isoamylalcohol so with the intention of the entire composition area is covered (i.e. 0-100% of the secondary alcohol). All the mixtures have been prepared by weight and kept in airtight bottles.

III. RESULTS AND DISCUSSION

The experimental results of ultrasonic velocity and density are deviation in isentropic compressibility, excess acoustic impedance and excess properties are fitted T type polynomial equation and the comparable standard deviations are evaluated. Hydrogen bonding in the mixtures. Besides, the experimental results of ultrasonic speed for the three schemes studied and are correlated with that of theoretically estimated values using different empirical relations.

Table 1: Comparison of experimental results of ultrasonic velocity (u) and density (ρ) of pure compounds with the comparable literature values at 308.15 K

Compound	Ultrasonic velocity $\frac{u}{m}.S^{-1}$		Density $\frac{\rho}{kg}.m^{-3}$	
	Present work	Literature	Present work	Literature
Ethanol	1108.45	1113.05	775.48	777.36
Formamide	1578.56	1578.01	110.10	1121.10
Isoamylalcohol	1209.40	1214.19	800.54	800.70
Ethanol	1108.45	1113.05	775.48	777.36

Table 2: Experimental results of ultrasonic velocity (u) and density (ρ) for all the schemes at 308.15 K with mole fraction (x) of isoamylalchohol.

EMM + isoamylalcohol			
X	Volume fraction	$\frac{u}{m}.S^{-1}$	$\frac{\rho}{kg}.m^{-3}$
0.0000	0.0000	1331.50	932.48
0.0436	0.0439	1315.80	914.68
0.0940	0.0945	1300.00	901.54
0.1607	0.1617	1282.46	887.23
0.3050	0.3065	1255.80	862.54
0.3995	0.4016	1243.94	848.81
0.5052	0.5075	1232.50	836.79
0.6455	0.6490	1219.70	821.97
0.8380	0.8195	1214.35	808.40
1.0000	1.0000	1210.42	800.54

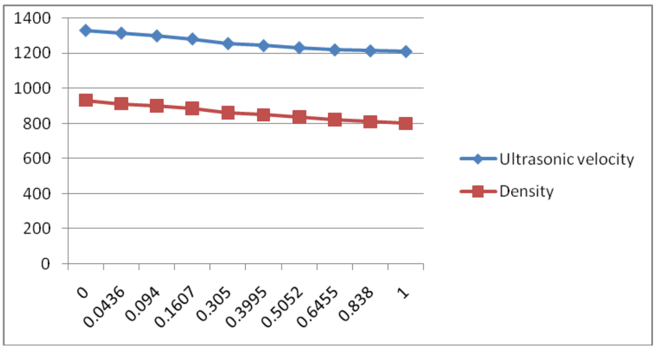

Figure 1 : Variation of Ultrasonic velocity and Density with mole fraction of isoamylalchohol with EMM

Table 3: Experimental results of Adiabatic Compressibility, Inter Molecular Free Length, Acoustic Impedance (Z) for all the schemes at 308.15 K with mole fraction (x) of Isoamylalcohol.

EMM + isoamylalcohol			
X	ADIABATIC COMPRESSIBILIT Y bad*10^(-10)M2/N	INTER MOLECULAR FREE LENGTH	ACOUSTIC IMPADANCE (Z)
0.0000	6.0489	7.7873	1.2414
0.0645	6.3146	7.9566	1.2035
0.1410	6.5633	8.1117	1.1720
0.2136	6.8529	8.2887	1.1378
0.3070	7.1045	8.4395	1.1098
0.3884	7.3515	8.5850	1.0831
0.4783	7.6136	8.7366	1.0558
0.5975	7.8670	8.8808	1.0313
0.7183	8.1778	9.0546	1.0025
0.8481	8.3885	9.1705	9.8168
1.0000	8.5259	9.2453	9.6899

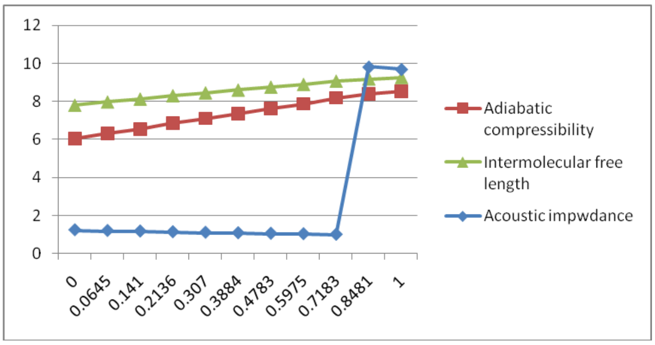

Figure 2: Variation of Adiabatic compressibility, Intermolecular free length and Acoustic impedance with mole fraction of isoamylalchohol with EMM

Table 4 : Calculated values of ultrasonic velocity from polynomials of $f(x)$ and $g(x)$ for all the schemes with mole fraction (x) of isopropanol/isobutanol/isoamyl alcohol

EMM + isoamylalcohol		
X	$f(x)$	$g(x)$
0.0000	1331.97	1332.08
0.0436	1315.33	1315.27
0.0940	1299.45	1299.45
0.1607	1282.58	1282.54
0.2281	1268.94	1268.89
0.3050	1256.21	1256.27
0.3995	1243.34	1243.27
0.5052	1231.72	1231.76
0.6455	1220.70	1220.72
0.8380	1213.96	1214.03
1.0000	1210.50	1210.51

Table 5: Percentage deviations of ultrasonic velocities from polynomials $f(x)$ and $g(x)$ for all the schemes with mole fraction (x) of isopropanol/isobutanol/isoamyl alcohol

EMM + isoamylalcohol		
X	$\%f(x)$	$\%g(x)$
0.0000	0.035	0.044
0.0436	-0.036	-0.040
0.0940	-0.042	-0.040
0.1607	0.009	0.006
0.2281	0.057	0.053
0.3050	0.033	0.037
0.3995	-0.048	-0.050
0.5052	-0.063	-0.060
0.6455	0.082	0.084
0.8380	-0.032	-0.030
1.0000	0.007	0.007

The standard deviations comparable to ultrasonic speed values calculated using the equation is presented in Table 4 and 5. The standard deviations presented in are very low obtained from the polynomial equations.

IV. CONCLUSION

Besides, the ultrasonic velocities gauge from different velocity theories are correlated with the experimentally measured ultrasonic velocities.Among these theories the Jacobson's velocity equation gives good agreement between the experimental and theoretical ultrasonic velocity values for all the schemes occupied.

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