ORIGINAL ARTICLE

The Study of Excess Molar Volume and Deviation in Viscosity of Binary Mixture of Propyl Amine in Benzene and Toluene at 311K Ultrasonically

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ABSTRACT

Densities, ultrasonic velocities and viscosities of propyl amine with benzene and toluene have been measured over entire range of composition at 311 K and atmospheric pressure. The computed acoustic and thermodynamic properties of propyl amine in benzene and toluene will give excess values of isentropic compressibility, molar volume and viscosity. The excess values will decide the nature and extent of molecular interaction of propyl amine with benzene and toluene at 311K.
Key words: *molar volume, viscosity, propyl amine, benzene, toluene*

INTRODUCTION

Ultrasonic velocity, density and viscosity related parameters such as isentropic compressibility, intermolecular free length, molar and available volume, yield valuable information about intermolecular interaction between the non-polar and polar molecules. The interaction behavior is due to deviation from ideality cause the solvent interaction[1-3]. Subbarangaiah *et al* [4] and Erying & Hirschfelder *et al* [5] investigated ultrasonic behavior of aqueous solution and discuss the results by hydrogen bonded complex formation. Verma *et al* [6-8] reported various thermodynamic parameters in binary mixtures of higher alcohols with benzene, toluene and carbon tetrachloride. The present investigation deals with the study of excess isentropic compressibility, molar volume and viscosity for binary mixtures of propyl amine in benzene and toluene.

EXPERIMENTAL DESIGN

Propyl amine, benzene and toluene were used after single distillation. Binary mixtures were prepared by mixing known volume of each liquid in air tight Stoppard glass bottle. Care was taken to avoid contamination during mixing.
Ultrasonic velocity was measured by Ultrasonic Interferometer M-80 manufactured by M/S Mittal Enterprises, New Delhi having accuracy of about ±0.057%.
Density of pure liquid and binary mixtures was measured by using double walled Picknometer. The Picknometer was calibrated with distilled water. The value obtained were tally with the literature values. The viscosities have been determined by using Ostwald viscometer. The accuracy in viscosity measurement was ±0.0002c.p.
Molar volume (Vm) were calculated by following relation-
$$V_m = M/\rho \qquad ....(1)$$

Where M is effective molecular weight and ρ is the density.

Excess value of molar volume (Vm^E) have been calculated by following formula

$$Vm^E = Vm_{exp} - (X_1 Vm_1 + X_2 Vm_2) \qquad ....(2)$$

Where Vm_{exp}, Vm_1 and Vm_2 are molar volumes of mixture and pure component 1 and 2 respectively and X_1 and X_2 are mole fraction of component 1 and 2.

Excess Viscosity has been calculated by using the relation

$$\eta^E = \eta_{exp} - (X_1\eta_1 + X_2\eta_2) \qquad ....(3)$$

RESULTS AND DISCUSSION

The values of ultrasonic velocity, density, excess isentropic compressibility, excess molar volume and excess viscosity are represented in Table 1 and 2.

Table-1 indicated ultrasonic velocity decreases with increasing mole fraction of the propyl amine. It is obvious that the moles of propyl amine are less dense that their density is less in comparable to benzene. The Vm^E values are positive for propyl amine with benzene.

As can be seen from Table 2 that ultrasonic velocity decreases with increasing mole fraction of propyl amine. It is obvious that the moles of thiophene are less dense that their density is less in comparable to toluene. The Vm^E values are positive for propyl amine with toluene1.

The η^E values are positive for propyl amine with benzene as well as positive for toluene.

Treszezanowics and Benson[9] suggested that Vm^E is resultant contribution from several opposing effects. These may be divided arbitrarily in to the three types, namely chemical, physical and structural. Physical contribution that is nonspecific interaction between the real species present in the mixture, contributes positive term to Vm^E. The chemical or specific interaction result in a volume decreases and these include charge transfer geometrical fitting type forces and other complex forming interactions. This effect contributes negative value to Vm^E. The structural contributions arising from (interstitial accommodation) of one component into another due to the differences in the free volume and molar volume between components lead to a negative contribution to Vm^E.

The negative deviations in viscosity -ve η^E. It expect non-specific molecular interactions between the unlike molecules. The tabulated experimental and computed data throw light on molecular interaction. The nature and extents of interaction define molecular interaction between the binary mixtures. The hexanol-1 having more carbon atom in alkyl group has least repelling power to other molecules and toluene.

Table 1: Mole fraction (X1) of propyl amine, ultrasonic velocity, density, excess molar volume and excess viscosity for propyl amine with benzene at 311 K

Mole Fraction of propyl amine X_1	Ultrasonic velocity v m/s	Density ρ (gm/l)	Excess Molar Volume (Vm^E) ml/mole	Excess Viscosity η^E
0.0000	1228	0.8360	0.00	0.0000
0.1316	1213	0.8097	-1.75	0.0007
0.2613	1196	0.7866	-1.61	0.0461
0.3890	1180	0.7641	-1.54	0.0022
0.5148	1164	0.7420	-1.51	-0.0911
0.6388	1148	0.7208	-1.59	-0.1139
0.7610	1132	0.7005	-1.79	-0.1139
0.8813	1116	0.6812	-2.15	-0.1369
1.0000	1098	0.6640	0.00	0.0000

Table 2: Mole fraction (X1) of Propyl amine, ultrasonic velocity, density, excess molar volume and excess viscosity for propyl amine with toluene at 311K

Mole Fraction of propyl amine (X_1)	Ultrasonic velocity v m/s	Density ρ gm/l	Excess Molar Volume Vm^E ml/mole	Excess Viscosity η^E c.p.
0.0000	1220	0.8232	0.00	0.0000
0.1535	1206	0.7987	0.60	0.0009
0.2973	1190	0.7767	0.87	0.0020
0.4323	1174	0.7558	0.99	0.0033
0.5593	1160	0.7327	1.40	0.0035
0.6790	1144	0.7161	0.98	0.0031
0.7920	1130	0.6974	0.82	0.0017
0.8988	1115	0.6793	0.59	0.0007
1.0000	1098	0.6640	0.00	0.0000

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