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RESEARCH ARTICLE

The Study of Excess Molar Volume and Deviation in Viscosity of Binary Mixture of Methyl Amine in Benzene and O-Xylene at 298K Ultrasonically

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ABSTRACT

Densities, ultrasonic velocities and viscosities of methyl amine with benzene and o-xylene have been measured over entire range of composition at 298K and atmospheric pressure. The computed acoustic and thermodynamic properties of methyl amine in benzene and o-xylene will give excess values of isentropic compressibility, molar volume and viscosity. The excess values will decide the nature and extent of molecular interaction of methyl amine with benzene and o-xylene at 298K.

Key words: *molar volume, viscosity, methyl amine, benzene, o-xylene*

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 (Rajendran, 1996; Jacobson, 1952 and Subbarangaiah, 1981) investigated ultrasonic behavior of aqueous solution and discuss the results by hydrogen bonded complex formation; and 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 methyl amine in benzene and o-xylene.

EXPERIMENTAL STUDY

Methyl 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

$$Vm = M/\rho \qquad \text{.....(1)}$$

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

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

$$Vm^E = Vm_{exp} - (X_1Vm_1 + X_2Vm_2) \qquad \text{.....(2)}$$

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

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

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.

Table 1: Mole fraction (X1) of methyl amine, ultrasonic velocity, density, excess molar volume and excess viscosity for methyl amine with benzene at 298 K

Mole Fraction of Methyl amine X_1	Ultrasonic velocity ν m/s	Density ρ (gm/l)	Excess Molar Volume (Vm^E) ml/mole	Excess Viscosity η^E
0.0000	1290	0.8734	0.00	0.0000
0.0423	1268	0.8789	- 0.46	- 0.0058
0.0905	1246	0.8844	- 0.86	- 0.0072
0.1457	1224	0.8899	-1.21	- 0.0086
0.2097	1202	0.8954	-1.48	-0.0090
0.2846	1180	0.9009	-1.66	-0.0085
0.3738	1158	0.9064	-1.74	-0.0076
0.4814	1136	0.9119	-1.67	-0.0065
0.6141	1114	0.9174	- 1,41	- 0.0048
0.7817	1092	0.9229	- 0.90	- 0.0038
1.0000	1062	0.9282	0.00	0.0000

Table 2: Mole fraction (X1) of Methyl amine, ultrasonic velocity, density, excess molar volume and excess viscosity for methyl amine with o-xylene at 298K

Mole Fraction of Methyl amine (X_1)	Ultrasonic velocity ν m/s	Density ρ gm/l	Excess Molar Volume Vm^E ml/mole	Excess Viscosity η^E c.p.
0.0000	1344	0.8865	0.00	0.0000
0.0315	1316	0.8907	- 0.62	- 0.0076
0.0682	1288	0.8947	- 1.18	- 0.0097
0.1115	1260	0.8991	- 1.69	- 0.0106
0.1633	1232	0.9033	- 2.12	- 0.0108
0.2264	1204	0.9075	- 2.45	- 0.0110
0.3051	1176	0.9117	- 2.65	-0.0104
0.4058	1148	0.9159	- 2.66	- 0.0092
0.5394	1120	0.9202	- 2.41	- 0.0076
0.7249	1092	0.9243	- 1.74	- 0.0500
1.0000	1062	0.9282	0.00	0.0000

The η^E values are positive for propyl amine with benzene as well as positive for toluene. Treszezanowics and Benson (1985) 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 tabulated experimental and computed data throw light on molecular interaction. The nature and extent of interaction define molecular interaction between the binary mixtures. The hexanol-1 having more carbon atom in alkyl group has least repelling power the negative deviations in viscosity -ve η^E. It expects non-specific molecular interactions between the two other molecules and toluene.

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