

Study of Dielectric Parameters of Binary Liquid Mixtures of 2-Aminopropane with Methanol at Microwave Frequency

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ABSTRACT

The binary mixture 2-aminopropane with methanol for different mole fractions have been measured at 10GHz microwave frequency .at 40° temperature. The viscosity(η), density(ρ),square refractive index (n_D^2)have measured of pure liquid and mixture also. These data is utilized to calculate various parameters such activation energy(E_a),molar polarization (P_{12}),The excess parameters are also estimated such as square of refractive index (Δn_D^2), viscosity ($\Delta\eta$) and activation energy (ΔE_a), These are used to explain the formation of complexes in system. Intermolecular interactions between the components in liquid mixtures were discussed.

Keywords: Dielectric constant, Microwave frequency and complex formation.

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I. INTRODUCTION

It is very important to know the intermolecular and intra molecular interactions for dipole study and hydrogen bonding .Hence the dielectric study of binary mixtures of both polar and non polar is important.

The dielectric investigations of binary polar liquid mixtures provide valuable information regarding intermolecular interactions and the consequent structural rearrangement of molecules in solutions several researches have reported the heterogeneous and homogeneous interactions in mixtures using dielectric parameters. The refractive index measurement with density and other analytical data have wide applications in chemical industry. The measurement of relative permittivity is useful in

characterizing the molecular structure ,solute-solute and solute-solvent interactions in solutions[1,5].

2-aminopropane is a organic compound with chemical formula C_3H_9N .It has average mass 59.110 Da , monoisotope mass 59.073498 Da, preferred IUPAC name as propane-2-amine.It is hygroscopic colorless liquid with ammonia like odour, it is miscible with water and flammable and used in bidegnate ligand in coordination chemistry and useful sale n type ligand.salpn is used as fuel additive as a metal deactivator in motor oils. It suppresses the catalytic activity[2]

Methanol is a polar liquid at room temperature .it is used as antifreeze, solvent, fuel and as a denaturant for ethanol methanol is essential in our lives everyday .It is also used in automotive antifreezes , in rocket fuels and as a general solvent .methanol is also

a high octane , clean burning fuel used in automotive vehicles the methanol derived from wood is used chiefly for rendering ethyl alcohol unfit to drink binary mixtures leads to polarization between molecules[6]

II. METHODS AND MATERIAL

The chemicals are used of A R grade and purified. The viscosities were measured with the help of Ostwalds Viscometer . The densities were measured using Picnometer .The refractive indices were measured by an Abbes refractometer. The measurements of ϵ' and ϵ'' were carried out at X-band bench at 10GHz using Surbers technique.

Dielectric Parameters :

The dielectric values are calculated by using following equations [10,11,12]

$$\epsilon' = \left[\frac{\lambda_o}{\lambda_c} \right]^2 + \left[\frac{\lambda_o}{\lambda_d} \right]^2 \quad \text{-----(1)}$$

$$\epsilon'' = \frac{2}{\pi} \left[\frac{\lambda_o}{\lambda_c} \right]^2 \left(\frac{\lambda_g}{\lambda_d} \right) \left(\frac{dQ}{dn} \right) \quad \text{----- (2)}$$

Where

λ_o is the free space wavelength

λ_c is the cutoff wavelength

λ_d is the dielectric wavelength

λ_g is the guide wavelength

Q Is the inverse of the voltage standing

Wave ratio

n is the number as (1,2,3,4,---)

$\frac{dQ}{dn}$ is the slope of Q Vs n

The viscosity equation is

$$\eta = \left(\frac{hN}{V} \right) e^{\left[\frac{E_a}{RT} \right]} \quad \text{-----(3)}$$

V is the molar volume of liquid

E_a is the free energy of activation

The molar polarization of the mixtures were obtained by using formula

$$P_{12} = \left(\frac{\epsilon' - 1}{\epsilon'' - 1} \right) \left[\frac{M_1 X_1 - M_2 X_2}{2} \right] \quad \text{-----(4)}$$

Where, M_1 and M_2 are the molecular weight, X_1 and X_2 are the mole fraction of the mixture.

The excess parameters can be obtained by using the relation

$$\Delta Y = Y_m - [X_1 Y_1 + X_2 Y_2] \quad \text{-----(5)}$$

Y refers for excess dielectric parameters. The subscripts 1 & 2 used for liquid (1) and liquid (2).

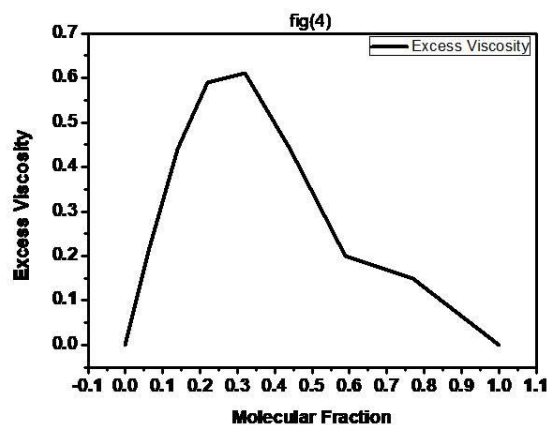
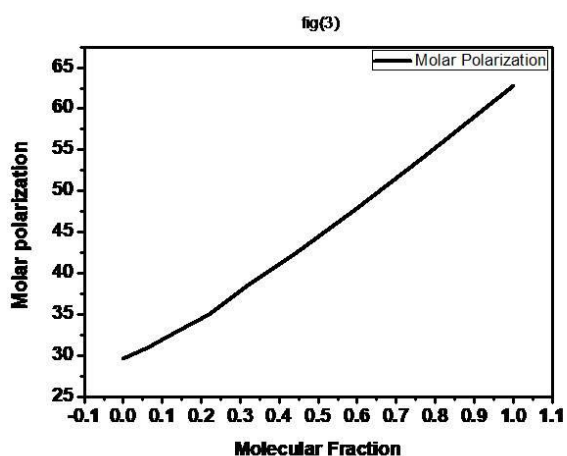
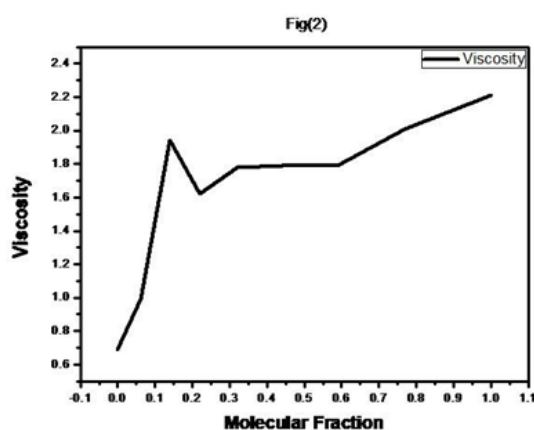
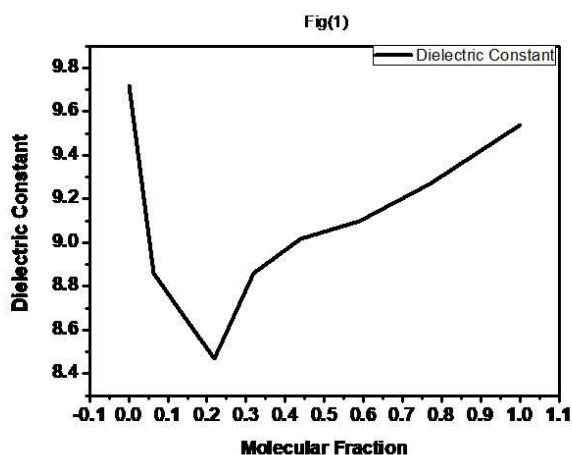
III. RESULTS AND DISCUSSION

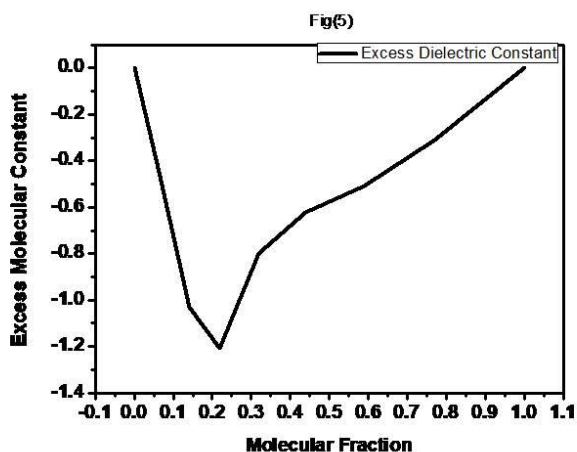
Table-1: The values of viscosity(η), square refractive index (nd^2), dielectric constant (ϵ'), dielectric loss (ϵ''), loss tangent ($\tan \delta$), activation energy(E_a) and molar polarization (P_{12}) with increasing mole fraction (X) of Amine propane (AP) with Methanol.

Sr. No .	X	Density ρ gm/cm ³	η	nd^2	ϵ'	ϵ''	Tan δ	E_a kcal/mol	P_{12}
1	0.00	0.80	0.69	1.78	9.72	2.40	0.25	3.01	29.65
2	0.063	0.81	0.99	1.88	8.86	2.15	0.24	3.22	30.95
3	0.14	0.82	1.94	2.09	8.66	2.17	0.25	3.41	32.97
4	0.22	0.84	1.62	2.07	8.47	2.73	0.32	3.53	35.00
5	0.32	0.86	1.78	2.04	8.86	2.24	0.25	3.58	38.53
6	0.44	0.87	1.79	2.04	9.02	2.42	0.27	3.58	42.41
7	0.59	0.873	1.79	2.06	9.1	2.44	0.27	3.58	47.56
8	0.77	0.88	2.01	2.09	9.27	2.73	0.29	3.65	54.07
9	1.00	0.884	2.21	2.09	9.54	2.55	0.27	3.71	62.76

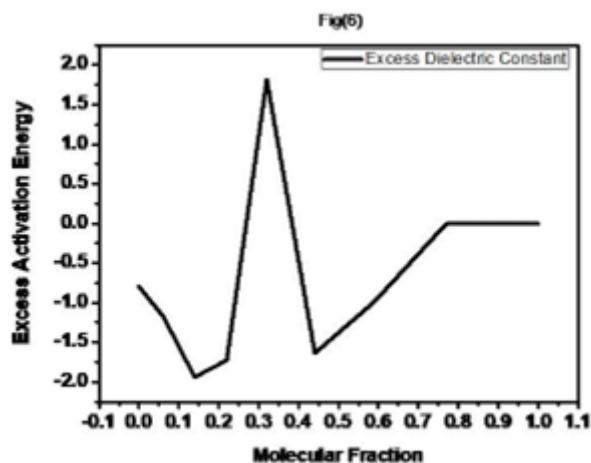
Table-2: The values excess of viscosity($\Delta\eta$), excess dielectric constant ($\Delta\epsilon'$), excess dielectric loss factor ($\Delta\epsilon''$), excess activation energy(ΔE_a) and excess molar polarization (ΔP_{12}) with increasing mole fraction (X) of Amine propane (AP) with Methanol.

Sr.No.	X	$\Delta\eta$	$\Delta\epsilon'$	$\Delta\epsilon''$	ΔE_a kcal/mol	ΔP_{12}
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.063	0.21	-0.45	-0.26	0.18	-0.79
3	0.14	0.44	-1.03	-0.26	0.30	-1.18
4	0.22	0.59	-1.21	0.30	0.36	-1.94
5	0.32	0.61	-0.80	-0.21	0.35	-1.73
6	0.44	0.44	-0.62	-0.04	0.27	1.81
7	0.59	0.20	-0.51	-0.05	0.16	-1.63
8	0.77	0.15	-0.31	0.22	0.11	-0.99
9	1.00	0.00	0.00	0.00	0.00	0.00





- The Variation of with X of AP in mixture is shown in fig(1)
- According to Narwade etal(7), The curve is nonlinear then there is complex formation and curve shows maximum deviation from linearity at X=0.22 of AP.
- The variation of with X of AP in mixture is shown in fig (2). The value of increases around 0.44 mole fraction of AP.
- There is solute-solute interaction between AP and Methanol. It shows stronger intermolecular dipole-dipole interactions. The increase in Viscosity up to 0.44 mole fraction may also be attributed to the mutual viscosity of alcohol-amine molecules as per Andrades's theory(4).
- The variation of P_{12} with X of AP in mixture is shown in fig (3) It shows the nonlinear and maximum slope occurs at X=0.22
- The variation of and X shown in Fig(4) The values are positive for entire range of mole fraction. It shows the string interaction between the unlike molecules of the system(3)
- The variation of and X is shown in fig(5). The excess dielectric permittivity is negative which is associated with polarization and excess loss is regarded due to molecular motions which are governed by complex forces of molecular interactions. It indicates total effective dipoles gets reduced(8,13,14).
- The variations of and X are as shown in fig(6) . All the values are positive for entire region, it



indicates strong interaction (9) between solute-solvent(7), which supports our earlier conclusion.

IV. CONCLUSION

- The study suggest that there is strong interaction in between 2-aminopropane and methanol molecules.
- The dielectric constant and viscosity curves suggest that there is complex formation of 1:1 complex in the binary mixture of 2-AP and Methanol.
- The experimental study suggest there is significant intermolecular interaction is present at temperature 40°C.

V. REFERENCES

- [1]. Ghanadzadeh A, Alinejad M, "Dielectric Study On Polar Binary Mixture of (Ster alcohol at 2.98K)", Iranian journal of chemical engineering vol.9, No.3,2012.
- [2]. Dabelstein W, Reglitzky A. etal "Automotive Fuels", Ullmann's Encyclopedia of Industrial Chemistry, Weinhein Wiley-VCH,2005.
- [3]. Das D.etal, "Electrical conductors of some symmetrical tetralkyle ammonium and alkalialalts in N, N-dimethyl Lactamide at250C".
- [4]. Hill N.E. etal "Dielectric properties and molecular behavior", Van Nostrond ,London,(1968).

- [5]. Meenachi M etal “Dielectric characteristics of binary mixtures of esters with hydrocarbons at 303K”, *Rasayam J.chem.*2015,8(1).P:98-104
- [6]. Gawali P.G.etal, “Molecular interaction studies of Etylene Diamine with 2-methoxyethanol at 9.85 GHz microwave frequency”, *Dionano Frontier*,2016;9(1)P.g.7-10.
- [7]. Gawali P.G. etal, “Dielectric studies of binary mixtures of n-propylalcohol diethykene amine” ,journal of chemical sciences,2005;117(6)P.g.673-676.
- [8]. Pawar v.P. and Mehrotra S.C, “Dielectric relaxation study of dimethylene chloride with ethanol using TDR”.*Journal of molecular liquids*,2003;108/1-3p.p.:95-105.
- [9]. Singh P.J. and Sharma K.s, “Dielectric behavior of Ketone Amine binary mixture at microwave frequencies”, *Pramana J.Phys*,1996;46(4):259-270.
- [10]. Sisodia M.L. and Raghuwanshi G.S. “Basic microwave techniques and lab manual”,wiley eastern Ltd, New Delhi , chapter 6, 1990.
- [11]. Surber W.H, “Universal cureves for Dielectric-filled wave guides and microwave dielectric measurements methods for liquids”,1948, *J.Appl.Phys.*19;514-520.
- [12]. Tumberphale U.B.etal “Dielectric behavior of aniline and propane diol binary mixture at 9.85GHz microwave frequency”, *International journal of bionano fronties*,2013;6(2);211-214.
- [13]. P G Gawali ,B K Bongane “Microwave dielectric properties of ferrites with various temperature and particle size”. *journal of research and development*, vol (8) , Dec 2017,UGC list No.64768.
- [14]. Undre P,etal “ microwave and optoelectronics” *Amaliya Publications ,Delhi*,p.p.:168.

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