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Thermoacoustic Study of Liquid mixture (n-Hexane+Isopropyl alcohol)

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ABSTRACT

The Ultrasonic velocity in different composition of binary liquid mixtures n-Hexane and Isopropyl alcohol at temperature 20^0C, 30^0C, 40^0C has been measured with the help of ultrasonic interferometer and for whole composition range. The molar cohesive energy is calculated for these binary mixtures.

Keywords: Ultrasonic Velocity, Effective Molecular Weight, Molar Cohesive Energy.

I. INTRODUCTION

Ultrasonic and thermo acoustic parameters of liquid crystal 8 OCB., physical properties of liquid crystalline 5-n-Hexyl-(4-n-alkyloxyphenyl)-pyrimidines and physical studies of a few nema togenic liquid crystals have been studies intensively by Y-Narasimha Murthy, R.N.V.Ranga Reddy and V.R.Murthy[1-3].Different acoustic and thermo acoustic parameters for these materials have been measured, calculated and analyzed the results on the basis of molecular interactions.

Ultrasonic velocity Measurement has been adequately employed in understanding the molecular interactions in pure, binary, and higher order multi-component liquid mixtures by Ana B. López et al., 2013; M. M. Papari et al., 2013; M. V. Rathnam et al., 2012; M. Sahin et al., 2011; S.C Bhatt et al., 2000; H.K.Semwal et al., 2003[4-9]. The propagation of ultrasonic velocity in a medium is a thermodynamic property and has come to be recognized as a very specific and unique tool for predicting and estimating various physio-chemical properties of the systems under consideration [10].

In this paper we have measured ultrasonic velocity at temperature 20^0C, 30^0C, and 40^0C and calculated molar cohesive energy in binary liquid mixture and the results have been shown in the figures for composition of binary liquid mixture vs. ultrasonic velocity and composition vs. molar cohesive energy at 20^0C,30^0C, and 40^0C temperature.

II. METHODS AND MATERIAL

A. Experimental

The Ultrasonic velocity measurements are extensively used to study physio-chemical behavior of liquids. Acoustic parameter like Ultrasonic velocity at 20^0C, 30^0C, and 40^0C have been determined, molar cohesive energy is calculated and results are tabulated and discussed. The following formulae have been used for calculations-

1. Ultrasonic velocity (U) calculated from the ultrasonic wavelength.

$$U = n\lambda$$

2. Viscosity of different composition of liquid mixtures calculated using the formula

$$\eta_1/\eta_2 = \rho_1 t_1/\rho_2 t_2$$

Where ρ_1 is the density, η_1 is the viscosity of water, t_1 is the time for flowing water through viscometer, while ρ_2 is density,t_2 is the time for flowing liquid mixture through viscometer and η_2 is the viscosity of liquid mixture.

3. The Molar cohesive can be represented as

$$\Pi_i V_m$$

Where

$\Pi_i = bRT\,(K\eta/U)^{1/2}\,\rho^{2/3}/M_{eff}^{7/6}$

B = Packing factor (Value of b = 1.78)

K = Dimensionless constant (having the value is 4.28×10^9)

T = Temperature

η = Viscosity

U = Ultrasonic velocity

M_{eff} = effective molecular weight [$M_{eff} = M_i X_i$]

Where M_i and X_i the molecular weight and mole fraction.

$V_m = M_{eff}/ \rho_{mix}$,

Where ρ_{mix} is the density of liquid Mixture.

B. Observation

Table-1.1: Ultrasonic velocity and Molar cohesive energy at different composition of liquid mixture n-hexane and Isopropyl alcohol at 20^0C

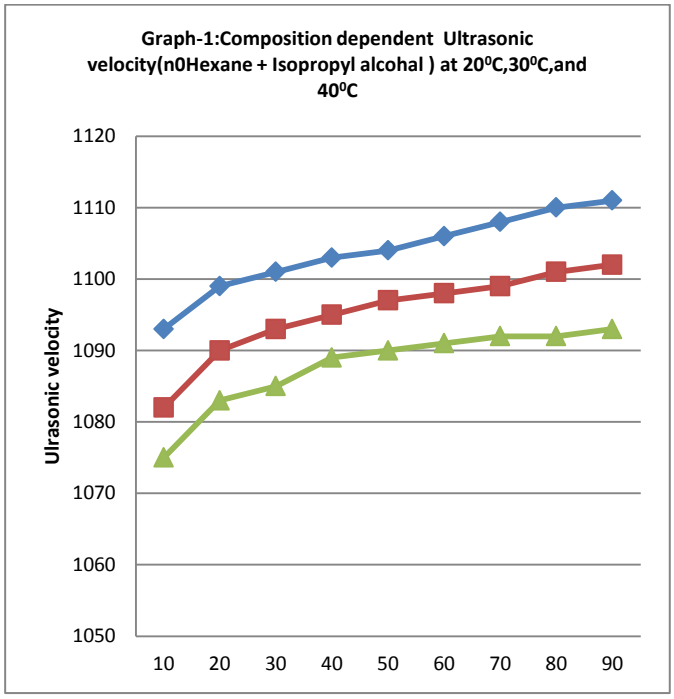
n-Hexane% + Isopropyl alcohol%	Density (Kg\CC)X-10^{-3}	Ultrasonic velocity At 20^0C	Molar cohesive Energy (lit-atm-mole)x10^4
10 90	0.591	1005	17.317
20 80	0.636	1008	16.236
30 70	0.606	1009	15.625
40 60	0.591	1011	13.023
50 50	0.588	1012	11.939
60 40	0.591	1014	11.750
70 30	0.588	1016	10.295
80 20	0.590	1017	11.602
90 10	0.598	1018	10.175

Table-1.2: Ultrasonic velocity and Molar cohesive energy at different composition of liquid mixture n-hexane and Isopropyl alcohol at 30^0C

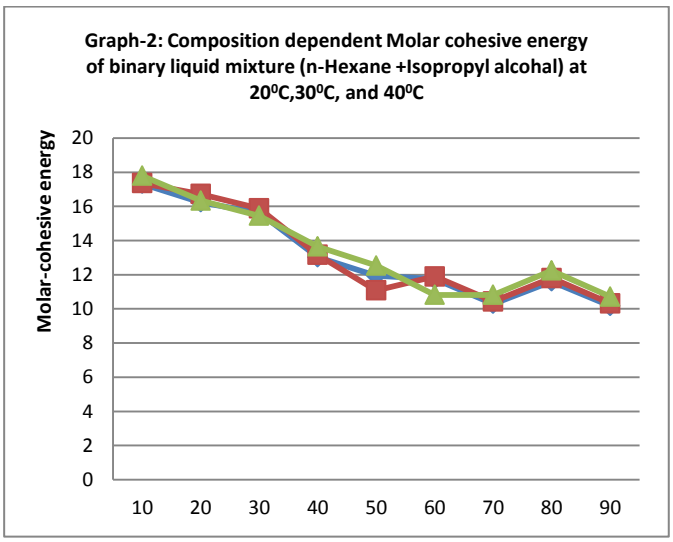
n-Hexane% Isopropyl alcohol%	Density (Kg\CC)X-10^{-3}	Ultrasonic velocity at 30^0C	Molar cohesive Energy (lit-atm-mole)x10^4
10 90	0.6563	999	17.3605
20 80	0.6513	1000	16.7258
30 70	0.6463	1002	15.8817
40 60	0.6413	1003	13.1618
50 50	0.639	1004	11.0840
60 40	0.6374	1007	11.8930
70 30	0.6323	1008	10.4308
80 20	0.6273	1009	11.8043
90 10	0.6223	1019	10.3229

Table-1.3 : Ultrasonic velocity and Molar cohesive energy at different composition of liquid mixture n-hexane and Isopropyl alcohol at 40^0C

n-Hexane% Isopropyl alcohol%	Density (Kg\CC)X-10^{-3}	Ultrasonic velocity at 40^0C	Molar cohesive Energy (lit-atm-mole)x10^4
10 90	0.653	992	17.7876
20 80	0.651	993	16.3403
30 70	0.646	997	15.4494
40 60	0.641	997	13.6459
50 50	0.639	997	12.5328
60 40	0.637	999	10.8142
70 30	0.632	1002	10.8142
80 20	0.627	1002	12.2383
90 10	0.621	1010	107143



Composition in %



Composition in %

III. RESULT AND DISCUSSION

Ultrasonic velocity has been measured by variable path interferometer at different composition at 20^0C,30^0C, and 40^0C temperature in Binary liquid mixture of a n-Hexane and Isopropyl alcohol.

Ultrasonic velocity and Molar cohesive energy in binary liquid mixtures (n-hexane + Isopropyl alcohol) at temperature 20^0C,30^0C, and 40^0C presented in table-1.1 , table-1.2, table-1.3, fig1 and fig-2. From the table and figure it is observed that in binary liquid mixture ultrasonic velocity is increases with increasing composition of n-hexane in liquid mixture at different temperatures.

From the table-1.1, table-1.2 and table-1.3 the ultrasonic velocity at 20^0C,30^0C, and 40^0C in binary liquid mixture is increasing with increasing composition of n-Hexane while Molar cohesive energy is decreasing.

IV. CONCLUSION

The variation of ultrasonic velocity and molar cohesive energy for different compositions in binary liquid mixtures n-Hexane and Isopropyl alcohol at 20^0C,30^0C, and 40^0C have been shown in table 1.1,table1.2, table1.3 and plotted graph in figures 1.1 & 1.2 respectively. From tables and figures it is observed that ultrasonic velocity slightly increases with increase the composition of n-Hexane & decreases with the composition of Isopropyl alcohol in liquid mixture at 20^0C While ultrasonic velocity slightly decreases for same composition as temperature increases. Molar cohesive energy decreases with increase of composition of n-Hexane while it slightly increases as increase the temperature.

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