Partial Molar Volume of binary mixtures of 8,10-dinitro-7h-benzo[c]carbazole in Ethanol, Acetone, DMF at different concentration,308.15 K

Pankaj S. Chaudhari*, Shrikant S. Patil[a]

* Department of Chemistry, Shri Vitthal Rukmini Arts,Commerce,Science College Sawana,Mahagaon, Dist-Yavatmal (M.S) India.

[a] Department of lifelong learning, Sant Gadge Baba University Amaravati (M.S) India

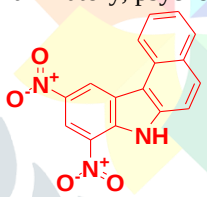
*Corresponding author: Dr. Pankaj S. Chaudhari asst. Prof. Department of Chemistry, Shri Vitthal Rukmini College Sawana,Mahagaon, Dist-Yavatmal (M.S) India.

Abstract: Ultrasonic velocity, density and viscosity of binary mixture 8,10-dinitro-7H-benzo[c]carbazole-70% Ethanol, 8,10-dinitro-7H benzo[c]carbazole -70% Acetone, and 8,10-dinitro-7H-benzo[c]carbazole –70 % DMF were measured at different concentrations of 8,10-dinitro-7H-benzo[c]carbazole and temperature at 308.15 K. Acoustical parameter like partial molar volumes were determined from experimental data of density, viscosity and ultrasonic velocity. The effect of concentration variations in the strength of molecular interaction has been studied. Effective correlation was observed in terms of solute-solvent and solvent-solvent interaction at all concentration.

Keyword: **Ultrasonic velocity, density, viscosity, partial molar volumes, 8, 10-dinitro-7H-benzo[c]carbazole.**

I. INTRODUCTION

Carbazole and its derivatives are an important type of nitrogen containing aromatic heterocyclic compounds, possess desirable electronic and charge transport properties, as well as large π- conjugated system, and the various functional groups are easily introduced into the structurally rigid carbazole ring[1]. Carbazole ring is present in a variety of naturally occurring medicinally active substances. For example, the Carbazomycin are an unprecedented class of antibiotics with a carbazole framework[2-3].These characteristics result in the extensive potential applications of carbazole-based derivatives in the field of medicinal chemistry (antitumor, antimicrobial, antihistaminic, anti-inflammatory, psychotropic agents)[4].



Structure of 8,10-dinitro-7*H*-benzo[*c*]carbazole

The studies of solution properties of liquid solution of polar and non-polar components have great applications in industrial and technological process[5].The recent publications in this area shows that the many researchers give attention toward study of ultrasonic velocity measurement and study of acoustical properties[6].

In view of broad biological activity of carbazole, due to this we here plan to study possible theoretical approach for the determination of ultrasonic parameters are useful for the studies of physicochemical properties and molecular interaction of any binary liquid.

II. MATERIAL AND EXPERIMENTAL

The compound 8, 10-dinitro-7H-benzo[c] carbazole synthesize by known method[7,8].The densities of Ethanol, Acetone, DMF and 8,10-dinitro-7H-benzo[c] carbazole solution were measured by using specific gravity bottle, mass measurements electronic balance and the viscosity was measured using Ostwald's viscometer. The ultrasonic velocities of pure components and their mixture were measured by ultrasonic interferometer (Mittal enterprises, model F-81s) at 2 MHz having accuracy ± 1 ms^{-1} in velocity**.**

2.1 Theory

Ultrasonic velocity can be used to calculated thermodynamic and acoustic parameter, which more reliable, precise and very useful in the study of molecular interaction in binary liquid mixture. Given acoustical parameters are calculated by using various equations.

Ultrasonic velocity (U):

The ultrasonic (u) can be measured using ultrasonic interferometer at the frequency 2MHz[9].

$$U = v \lambda \quad (1)$$

Where, u is the ultrasonic velocity, λ is the wavelength.

Partial Molar Volume (V_b):

The partial molar volumes have to be extrapolated to concentration zero using the following equation which calculate the apparent molar volume at the finite concentrations (C)[10].

$$V_b = (M/p^0)-10^3/C *[p/p^0-1] \quad (2)$$

Where, M-molecular weight (M is the molar mass of the solute) of solute, p-density of solution, P^0- density of solvent, c-molar concentration.

III. RESULTS AND DISCUSSION

Experimental determined values of ultrasonic velocity u (ms^{-1}), density ρ (g cm^{-3}) and viscosity η (10^{-3} Nsm^{-2}) for the binary mixture of 8,10-dinitro-7H-benzo[c]carbazole -70% Ethanol , 8,10-dinitro-7H-benzo[c]carbazole – 70% Acetone and 8,10-dinitro-7H-benzo[c] carbazole DMF solutions at temperatures 308.15 K are given in Table 1.

Table 1. Experimental values of ultrasonic velocity, density and viscosity of 8,10-dinitro-7H-benzo[c]carbazole -70% Ethanol (■), 8,10-dinitro-7H-benzo[c]carbazole – 70% Acetone (▲) and 8,10-dinitro-7H-benzo[c]carbazole – 70% DMF (×) binary mixture at 307.15 K. [L = 8,10-dinitro-7H-benzo[c]carbazole]

C,mol/lit	u, $m.s^{-1}$			(ρ) $kg.m^{-3}$			(η) × 10-3 Nsm^{-2}		
	70% Ethanol+L	70% Aceton+L	70% DMF+L	70% Ethanol+L	70% Acetone+L	70% DMF+L	70% Ethanol+L	70% Acetone+L	70% DMF+L
0.01	1372	1192	1362	0.9322	0.9626	0.952	1.021	0.733	1.558
0.02	1427	1204	1383	0.9427	0.9586	0.966	1.051	0.756	1.578
0.03	1431	1212	1415	0.9478	0.9686	0.979	1.075	0.77	1.595
0.04	1439	1291	1463	0.9496	0.9566	0.988	1.081	0.775	1.624
0.05	1448	1368	1496	0.9525	0.9706	1.007	1.111	0.778	1.638
0.06	1524	1392	1527	0.9555	0.9646	1.022	1.2	0.782	1.656
0.07	1599	1393	1552	0.9566	0.9646	1.038	1.21	0.788	1.664
0.08	1672	1403	1598	0.9575	0.9656	1.057	1.255	0.795	1.689
0.09	1673	1513	1636	0.965	0.9706	1.077	1.34	0.814	1.702
0.1	1688	1545	1684	0.975	0.9716	1.095	1.356	0.822	1.735

From fig.1 it is observed that ultrasonic velocity increases with increase in concentration of 8,10-dinitro-7H-benzo[c]carbazole at constant temperature, also fig.2 and fig.3 indicates increase of density and viscosity with increase in concentration of solute at constant temperature. An increase in concentration allows for a closer approach of solvent and solute molecules, and stronger association between solute and solvent molecules. This leads to decrease in the volume and an increase in the density of the solution[12]. The increase values of viscosity and ultrasonic velocity indicates molecular association in the experimental systems, which is possible due to the presence of amine group solute structure, it is notable that molecular interactions are less at lower values of velocities[13]. It may be due to breaking of molecular clusters, presence of dipole-dipole interaction, solute – solvent interactions, solvent - solvent interactions and presence of hydrogen bonding between solute molecule and water molecule solvent.

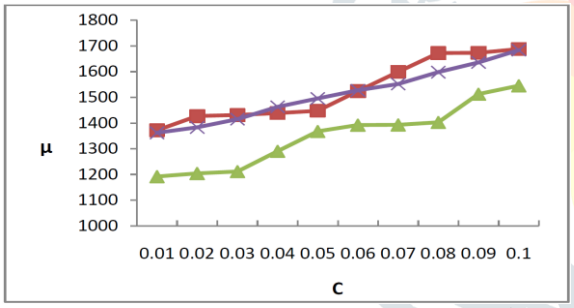


Figure 1 Ultrasonic velocity (u) plotted against concentration of 8,10-dinitro-7H-benzo[c]carbazole -70% Ethanol (■) , 8,10-dinitro-7H-benzo[c]carbazole – 70% Acetone (▲) and 8,10-dinitro-7H-benzo[c] carbazole DMF (×) binary mixture at 307.15 K.

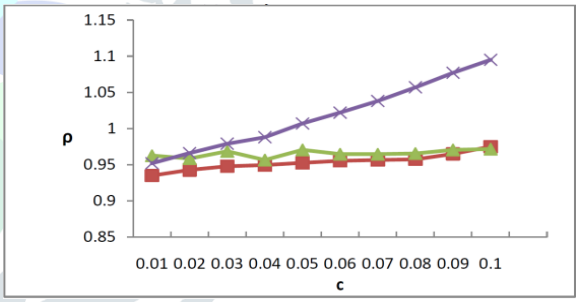


Figure 2 Density (ρ) plotted against concentration of 8,10-dinitro-7H-benzo[c]carbazole -70% Ethanol (■), 8,10-dinitro-7H-benzo[c]carbazole – 70% Acetone (▲) and 8,10-dinitro-7H-benzo[c]carbazole DMF (×) binary mixture at 307.15

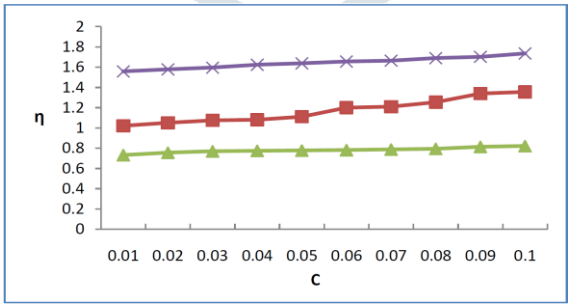
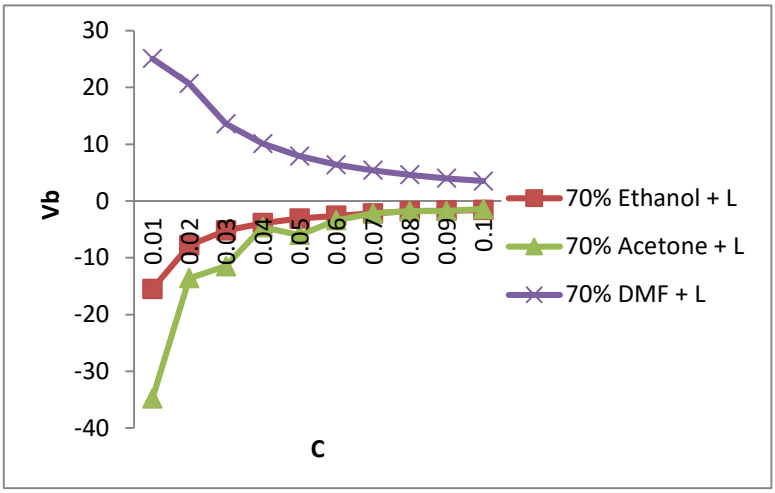


Figure 3 : Viscosity (η) plotted against concentration of 8,10-dinitro-7H-benzo[c]carbazole -70% Ethanol (■), 8,10-dinitro-7H-benzo[c]carbazole – 70% Acetone (▲) and 8,10-dinitro-7H-benzo[c]carbazole DMF (×) binary mixture at 307.15 K.

From these figures **4**, it is evident that the partial molar volumes exhibit a slight increase and decreases with increasing concentration within the concentration range investigated here. the concentration dependence of partial molar volumes follows one and solvent composition investigated. The slopes of V_b vs concentration graph are always found to be positive in 8,10-dinitro-7H-benzo[c]carbazole DMF mixtures, indicating strong ion-ion interactions in these mixture[14] and negative in 8,10-dinitro-7h-benzo[c]carbazole acetone ,ethanol indicating that weak interaction due to The intermolecular bonding between the solute particles and solvent particles like, Vander Waals forces, dipole-dipole interaction, are disturbed and broken and a new bond between a solute and a solvent particle is formed.



C, mol/lit	Vb = (M/p0)-10^3/C*[P/P0-1]		
	70% Ethanol+L	70% Acetone+L	70% DMF+L
0.01	-14.7	-34.8	25.1
0.02	-7.8	-13.6	20.7
0.03	-5.2	-11.5	13.6
0.04	-3.9	-4.6	10.1
0.05	-3.1	-6	7.9
0.06	-2.6	-3.4	6.4
0.07	-2.2	-2.2	5.4
0.08	-1.8	-1.8	4.6
0.09	-1.7	-1.8	4
0.1	-1.6	-1.4	3.5
Partial molar volume(Vb)(cm3.mol-1)			

Figure 4 : Partial molar volume plotted against concentration of 8,10-dinitro-7H-benzo[c]carbazole -70% 9Ethanol (■) , 8,10-dinitro-7H-benzo[c]carbazole – 70% Acetone (▲) and 8,10-dinitro-7H-benzo[c]carbazole DMF (×) binary mixture at 307.15K.

IV CONCLUSION

The nature of intermolecular interaction in a binary mixture solution has been explained on the basis of density, viscosity, ultrasonic velocity and acoustical parameter. Result revels that density, viscosity, ultrasonic velocity aqueous solution increases with increases whereas these values are found to decrease as the relative permittivity of the medium decreases in concentration at 307.15K. From these measured physical property data Partial molar volume are calculated. From above investigation it is found that 8, 10-dinitro-7H-benzo[c] carbazole shows interesting interactive behavior with solvent like ethanol, acetone and DMF.

The result also give the scope for investigation acoustical parameter of various substituted carbazole which help to used more application of biological active carbazole.

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