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Molecular interaction studies between acetylcholine with primary alcohols

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Abstract

Ultrasonic velocity, density and viscosity of binary mixtures of Acetylcholine and Propanol have been measured at room temperature 303K. Using the measured velocity the thermodynamic parameters such as adiabatic compressibility (β), inter molecular free length (L_f), Acoustic impedance (Z), free volume (V_E) have been calculated. It has been established that ultrasonic velocity decreases with increasing the mole fraction. The results show a nonlinear variation of acoustical parameters, confirms the presence of molecular associative nature in this binary mixture.

Keywords: Ultrasonic velocity; Binary mixtures; Molecular interaction.

1. Introduction

Ultrasonic technique is one of the powers now days in all the fields. The ultrasonic study plays an important role in the study of Physico-Chemical properties of the liquids. The interaction of molecule in the liquid mixture can be predicted by measuring the thermodynamic properties like velocity, density and viscosity. The variation of this parameter gives the vital information of the intermolecular interaction [1]. Acetylcholine is known for his biological and pharmaceutical application in many fields [2]. Acetylcholine (ACh) is an organic chemical that functions in the brain and body of many types of animals, including humans, as a neurotransmitter, a chemical released by nerve cells to send signals to other cells. Many studies have suggested a wide range of potential therapeutic or preventive effects associated with Acetylcholine like antitumor, anti-oxidant, and anti-inflammatory [3-5]. Alcohols are one of the important organic chemical and plays significant role in many chemical reactions of bio-molecules. Many drugs can be prepared by the using the alcohols. Example: Benadryl is used as common solvent for paints, glues and nail varnish [6].

2. Materials and methods

An ultrasonic interferometer supplied by M/s.Mittal Enterprises, New Delhi, having the frequency 2MHz with an overall accuracy of ± 2 ms^{-1} has been used for ultrasonic velocity measurement. The chemicals used in the present work were analytical reagent (AR) grades obtained from SD fine chemicals India and used without further purification. In all systems, the various concentrations of the binary liquid mixtures were prepared in terms of mole fraction varied from 0.1 to 0.7.Acetylcholine in chlorine is purchased from sigma chemical Ltd. It is dissolved in acetone and made stock solution. The density of pure liquids and liquid mixtures are determined using a Specific Gravity bottle by relative measurement method with an accuracy of ± 0.1mg. An Ostwald's Viscometer which is 10ml capacity is used for the viscosity measurement of pure liquids and liquid mixtures.

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Ultrasonic velocity is calculated for using relation U = n χ m/s

Adiabatic compressibility $\beta = \frac{1}{\rho U^2} ms^2 kg^{-1}$

Intermolecular free length $L_f = \sqrt{\beta}\ K_T$ Kg m^{-2} s^{-1}

Acoustic impedance $Z = U\rho$

Where n, $\boldsymbol{\rho}$, $\boldsymbol{\eta}$, M is the frequency of the ultrasonic wave, density, viscosity and molecular weight of the mixtures. K_T is the constant. They are temperature dependent and the value is 4.28 x 10^9.

3. Result and conclusion

Values of Ultrasonic velocity (U), Density (ρ) and Viscosity (η) are measured for the binary mixture of Acetylcholine with 1-propanol systems at 303K are presented in Table-1.The values of adiabatic compressibility (β), inter molecular free length (L_f), free volume (V_f) and acoustical impedance (Z) at the temperatures of 303K are calculated.

Table 1 Value of ultrasonic velocity (U), Density (ρ) and Viscosity (η)

Mole Fraction		**For propanol with Acetylcholine**		
X_1	X_2	ρ in Kg m^{-3}	η x 10^3 in Ns m^{-2}	U in ms^{-1}
0.1	0.7	715.21	0.7822	1102
0.2	0.6	805.21	0.8321	1058
0.3	0.5	754.89	0.9562	998
0.4	0.4	875.54	1.1356	975
0.5	0.3	956.34	1.2761	852
0.6	0.2	988.61	1.3521	821
0.7	0.1	978.25	1.3842	811

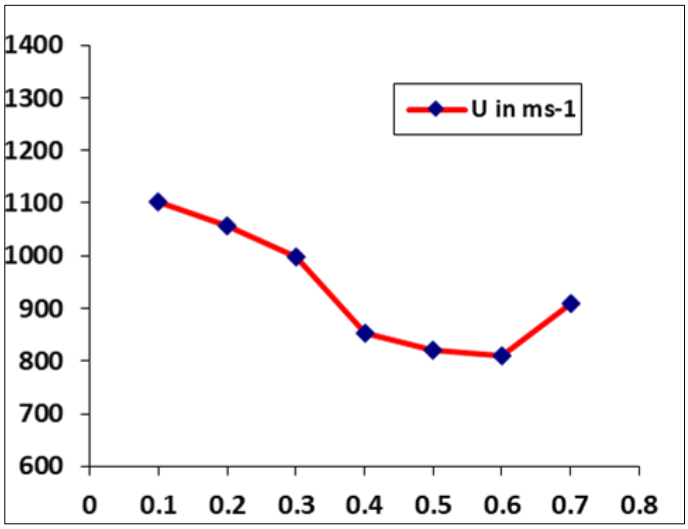

Figure 1 Variation of ultrasonic velocity with Mole fraction

X – axis: Mole fraction and Y – axis: Ultrasonic velocity.

Result from Table-1 shows the ultrasonic velocity decreases with increasing mole fraction and viscosity and density increases as the concentration of 1-propanol increases, this clearly indicates the intermolecular interaction in the binary fluid systems. Result shows there is moderate attraction between molecules. The decreasing velocity shows molecules of components are attracted by hydrogen bond. Figure-1 shows the decreasing variation of ultrasonic velocity with mole fraction of 1-propanol. The magnitude of the density increases and viscosity also increases. This clearly indicates the increase of frictional resistance force. This is due to change in molecular area or cohesive or adhesive force between the molecules. Adiabatic compressibility, intermolecular free length values are calculated by measured values of ultrasonic velocity, viscosity and density. The Adiabatic compressibility, intermolecular free length values shows increase trend with increase concentration of the 1-propanol.

The adiabatic compressibility increases with decreasing the ultrasonic velocity clearly shows the presence of molecular interaction between the molecules of 1-propanol with Acetylcholine binary mixtures. Values for free volume and acoustical impedance are calculated by measured values of density. The reverse trend is observed that is decreases trends for free volume and acoustical impedance values with increasing the mole fraction of the 1-propanol. This shows presence of interaction between Acetylcholine with 1-propanol molecules. The structural geometry of molecules in the mixture depends on the adiabatic compressibility, the increasing in the adiabatic compressibility shows the progressive intermolecular interaction between the molecules. However, the increase in adiabatic compressibility and inter molecular length is also attributed to the internal interaction between the molecules of the binary mixtures.

4. Conclusion

From measured ultrasonic velocity, density and viscosity, the related acoustical parameter for the binary mixture are calculated. It is noticed that sound velocity decreases with increasing mole concentration and adiabatic compressibility is increases with increasing mole concentration. This result shows existences an interaction and it can be concluded that there is an intermolecular interaction present in the binary mixture.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to disclosed.

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