Effects on Ultrasonic Velocities, Densities, Viscosities & Refractive Indies of Nicardipine Hydrochloride at Different Temperatures

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ABSTRACT

Densities, viscosities, refractive indices and ultrasonic velocities of the Nicardipine hydrochloride drug were measured over the entire mole fractions at (88.210, 74.561, 72.157& 68.108) K. From these experimental results, excess molar volumes VE, viscosity deviation Δη, refractive index deviation ΔnD, deviations are calculated. It was found that in all cases, the data obtained fitted with the values correlated by the corresponding models very well. The results are interpreted in terms of molecular interactions occurring in the solution.

Keywords: Viscosity; Density bottle, Refractive Index; Ultrasonic Velocity; Molecular interactions.

I. INTRODUCTION

Measurements of physico-chemical properties such as viscosity, density, ultrasonic velocity and refractive indices of pure components and their mixtures are being increasingly used as tools for investigations of the properties of pure components and the nature of intermolecular interactions between the components of liquid mixtures Singh et al., (2011) &Pradhan et al., (2012).Ultrasonic studies have found wide applications owing to their ability to characterize the physico-chemical behavior of solutions. The measurement of ultrasonic velocity can provide useful information regarding the degree of deviationfrom ideality, internal structure, complex formation and molecular interaction in liquids because there accuracy,Palani & Balakrishna, (2010). Viscosity is one of the important properties of liquid. It relies on its molecular size, shape and intermolecular attraction. The viscosity measurement like other transport properties of electrolyte provides useful information about the solute-solute and solute- solvent interaction. There are certain acoustical parameters which rely on viscosity, Sharma et al., (2008).

Ultrasonic and density studies have found wide application owing to their ability to characterize the physicochemical behavior of solutions Naik, (2015).The measurement of various parameters; density, viscosity, refractive indices and ultrasonic velocity of materials are important for process control in most of industrial processes Mandakmare et al., (2014). The substantial work also has been reported by many researchers Muley et al., (2014); Muley et. al., (2014).Studies were also made on viscosity, surface tension and volume flow rate in some of the medicinal oils to determine environmental influences, compositional, structural and physiological alterations and aging factors by Nazima Siddiqui, et al (2013).

Hence, in the present studies focused on the various aspects like ultrasonic velocities, densities, viscosities & refractive Indies of organic compounds. Unfortunately there is very little literature is available to correlate our obtained results. For this we select drugs like Nicardipine hydrochloride, are the organic compound which is widely and commonly used in the treatment of different types of disease. The Nicardipine is used with or without other medications to treat high blood pressure (hypertension).Lowering high blood pressure helps prevent strokes, heart attacks, and kidney problems. Nicardipinehydrochloride is called a calcium channel blocker. It works by relaxing blood vessels so blood can flow more easily. Nicardipinehydrochloride is also used to prevent certain types of chest pain (angina). It may help to increase your ability to exercise and decrease the frequency of angina attacks. This medication must be taken regularly to be effective. It should not be used to treat attacks of chest pain when they occur. Literature survey showed that no measurements have been previously reported for the drugs studied in this paper.

II. EXPERIMENTAL SECTION

Materials and Methods

All the chemicals used in this study were of analytical grade and obtained from Lobo Chemicals, India. The claimed mass fraction purity for the chemicals was ≥0.998. These chemicals were dried over molecular sieves and partially degassed prior to use. The purity of these experimental chemicals was checked by comparing the observed densities, viscosities, refractive indices and velocities with those reported in the literature. The measured values are included in Table 1 along with the available literature values.

Preparation of aqueous solutions for present study: for present study were prepared in triply distilled deionized water by weight-by weight method in airtight stoppered glass bottle. Dhona balance to an accuracy of ±1 ×10–5 g was used to record the masses. Density and viscosity measurements at different temperatures were undertaken by using glass-walled water bath. The Bi-capillary Pycnometer, Ubbelohde Viscometer, and Ultrasonic Interferometer were calibrated with triply distilled deionized water (conductivity 0.054 μS) before the measurements of density, viscosity, ultrasonic velocity, and refractive indices. Uncertainties in the density, viscosity, ultrasonic velocity, and temperature measurements were 5.8 ×10–2 kg m–3, 4.71 ×10–7m–1 kg s–1 , 0.23 m s–1 , and 0.006 K, respectively.

Density:

Densities were determined by using a 25 cm3 bicapillary pycnometer and calibrated with deionized double distilled water with a density of 996.0 kg ·m-3 at a temperature of 303.15 K. The pycnometer was thermostatted in a transparent walled water bath (maintained constant to ± 0.01 K) for 15 min to attain thermal equilibrium, and the liquid level in the two arms was obtained with a traveling microscope which could read to 0.01 mm. The precision of the density measurements was estimated to be ± 0.0003 g ·cm-3.

Viscosity

The kinematic viscosities were measured with Mansingh surviemeter previously calibrated using water. The time was measured with a precision of 0.01s, and the uncertainty in the viscosity was estimated to be less than 0.0003 mPa·s. The kinematic viscosity was obtained from the working equation

$\nu = at - b/t$

Ultrasonic Velocity: Ultrasonic Velocity Measurements the three experimental techniques used for the measurements of ultrasonic velocity are interferometer method,for present study, a single crystal variable path interferometer has been employed for the measurements of ultrasonic velocity of aqueous solutions.The test solution in the cell is allowed to thermally equilibrate. The micrometer was rotated very slowly so as to obtain a maximum or minimum of anode current. A number of maximum readings (n) of anode current were counted. The total distance (d) travelled by the micrometer for n =10 were read. The wave length (λ) was determined by the equation

$\lambda = {}^{2d}/_{n}$

Refractive Indices: Refractive Index Measurements For pure solvent, the refractive index, n, is a constant. It can be defined as the ratio of the speed of a wave either light or sound in a reference medium to a second medium.

$$n = \frac{\text{Speed of light in medium 2}}{\text{Speed of light in medium 1}}$$

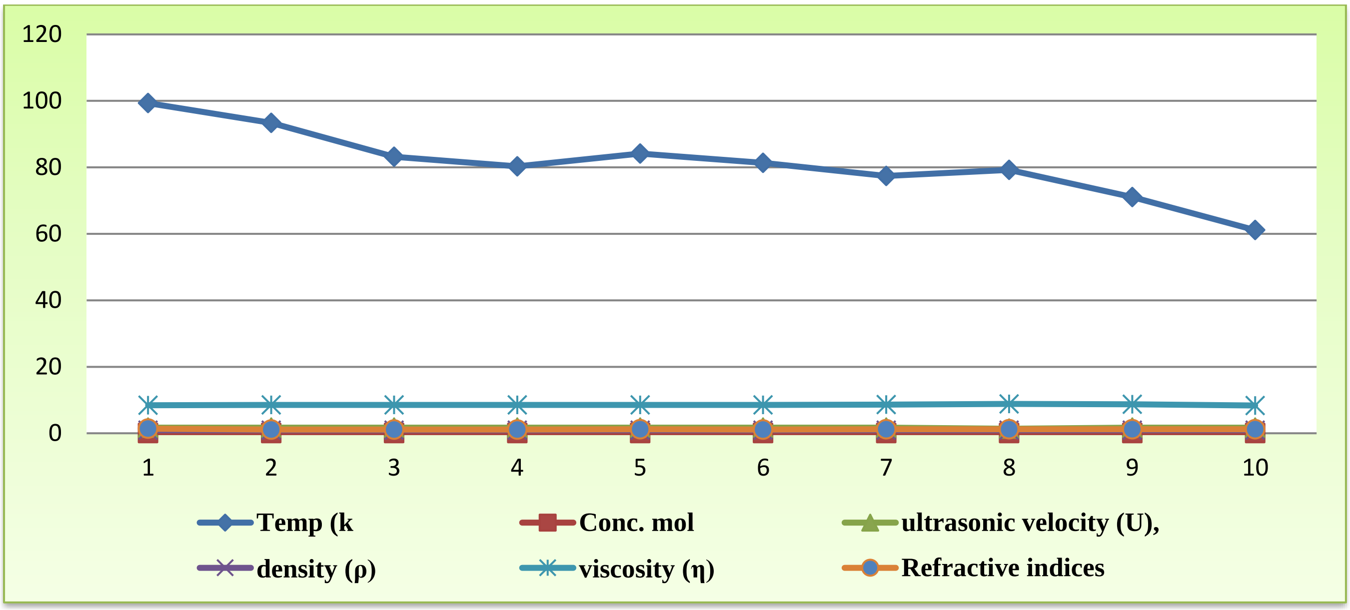
The incident light is in material 1 and the refracted light is in material 2. Abbes refractometer was used for the measurements of refractive indices of aqueous solutions. Refractive index range of refractometer was 1.3000 – 1.7000. Accuracy in the refractive index measurements was ± 0.0002. Refractometer operates on the critical angle principal. For measurements of refractive of the liquid/solution, the liquid/solution sample was added on the surface of the refracting prism with a clean dropper. The refracting prism was covered by light entering prism and both prisms were locked with hand wheel Kharat and Nikam, (2003).For the measurements of refractive indices at different temperatures water at different temperatures was circulated through the refractometer by pump. Before the measurements refractive indices of aqueous solutions, the refractometer was calibrated with piece of glass of known refractive index provided with the instruments. To check the calibration, the refractive indices of distilled water were measured at different temperatures.

III. RESULTS AND DISCUSSION

Measured values of densities, viscosities, refractive indices and ultrasonic velocities of Nicardipinehydrochloride at temperatures of (99.321, 93.361, 83.153 & 61.108) K are listed in Table 1.

Sr.no.	Temp (k)	Conc. mol	ultrasonic velocity (U),	density (ρ)	viscosity (η)	Refractive indices
1	99.321	0.01	1.6512	0.9441	8.4517	1.3684
2	93.361	0.02	1.6541	0.9472	8.5687	1.1156
3	83.153	0.03	1.6713	0.9457	8.4763	1.1564
4	80.342	0.04	1.6511	0.9423	8.5631	1.1224
5	84.102	0.05	1.6423	0.9378	8.5614	1.2341
6	81.394	0.06	1.6567	0.9389	8.5674	1.1348
7	77.421	0.07	1.6648	0.9349	8.6342	1.1634
8	79.210	0.08	1.3641	0.9457	8.8231	1.1863
9	71.103	0.09	1.6478	0.9486	8.7531	1.1623
10	61.108	0.1	1.6842	0.9487	8.3542	1.2142

Table no.1 Showing the fluctuation of ultrasonic velocity, density, viscosity & refractive indices of Nicardipinehydrochloride against concentration



Graph no.1 Showing thefluctuation ultrasonic velocity, density, viscosity & refractive indices of Nicardipinehydrochlorideagainst concentration

Density (ρ): The density of the drug is measured throughout the experimental period and concentration at various temperatures. The density was highly increased in 0.1m at 61.108(k), followed by 0.09m at 71.103(k) & 0.05m at 84.102(k) &0.02m at 93.361(k). The highest density was decreased in the 0.04m at 80.342 (k) followed by 0.01 m at 74.561 (k) was observed.

Ultrasonic velocity (U): The ultrasonic velocity is highly increased in the 0.1 m at 61.108 (k) followed by 0.03 m at 83.153 (k). The ultrasonic velocity is highly decreased in 0.08m at 79.210 (k) was observed.

Viscosity (η): The viscosity is highly increased in the 0.08m at 79.210 (k) followed by 0.09m at 71.103 (k) 0.07m at 77.421 (k). The viscosity is highly decreased in 0.1 m at 61.108 (k) was observed.

Refractive indices: The refractive indices is highly increased in 0.01m at 99.321(k) while it was highly decreased in 0.02 m at 93.361 (k) followed by 0.04 m at 80.342 (k), 0.06 m at 81.394 (k).

In the present studies in both the drugs the increase in density is due to increase of solute particles in solution and decrease in density is due to rise of volume of solution with increase temperature Patil & Dudhe, (2015); Patil & Dudhe (2015). Also the decrease in density with increase in temperature might be due to decrease in intermolecular forces due to increase in thermal energy of the system Praharaj et al., (2012).

At lower temperature, viscosity is found greater because of intermolecular forces due to the increase in solute which causes attraction between the solvent and solute it shows the structure making capability of solute in the solution Patil, Singh, (2018). With increasing temperature there is weakening of cohesive forces that result in decrease in viscosity Patil & Dakhane, (2018).The ultrasonic velocity in the present investigation increases with concentration and temperature increases. The closed-packed structure forms stiff material medium for the propagation of ultrasonic wave due to which ultrasonic velocity increases Talukdar et al., (2013).This indicates that there is significant interaction between ion and solvent molecule suggesting a structure promoting behavior solute. Tayadeet al.,(2014).In the present investigation in Nicardipine hydrochloride the temperature is increases all the parameters get changed. Similar results was obtained in another studies and reported that asthetemperature is increased, available thermal energy facilitates the breaking of the bonds between the associated molecules. Moreover, increase of thermal energy weakens the molecular force which tends to decrease ultrasonic velocity Raj et al.,(2009).The ρ, η and U values increased linearly with concentration (C). The densities of the solutions increase with C. Thus, the rule of additivity of density is observed. The ρ, η and U data were correlated with the concentration C and found to have a fairly good-to-excellent correlation between a given parameter. The variation of η and U with C is considerably more than that of ρ due to specific molecular interactions. Molecular interactions depend on the strength of the repulsive forces acting amongst solvent and solute molecules and hence intermolecular motion is affected accordingly.

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V. REFERENCES

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