TO STUDY INTERMOLECULAR INTERACTION OF SOME BINARY LIQUID MIXTURES OF CHLOROFORM, ACETONE, M-XYLENE, CYCLOHEXANE IN DMSO

Dr. Dheeraj Kumar

Extension Assistant Professor in Government College, Narnaul, Haryana, (India)

ABSTRACT

Binary mixtures are prepared by mixing appropriate volumes of the liquid component in the specially designed glass bottles with air tight Teflon coated caps. The required properties are measured on the same day immediately after preparing each composition. The uncertainty in mole fraction is ± 0.0001. A multi frequency digital micrometer reading ultrasonic interferometer (M-81, Mittal Enterprises, New Delhi) operating at 1, 2, 3 and 4 MHz was used to measure the ultrasonic velocity of the binary liquid mixtures (with an uncertainty of ± 0.3 %) at a constant temperature of 303.15 K by using a digital constant temperature water bath. The temperature stability is maintained within ± 0.001 K by circulating thermostated water around the cell with a circulating pump. In order to minimize the uncertainty of the measurement, several maxima are allowed to pass and their number (fifty) is counted. All maxima are recorded with the highest swing of the needle on the micrometer scale.

Key Word: Digital micrometer, Glass bottles, Temperature of 303.15 K.

I. INTRODUCTION

Binary mixture involves intermolecular forces which are of interest to Chemists, Physicists and Engineers and have many applications in fundamental sciences and industries. Due to extreme sensitivity of excess functions, information about the inter-molecular forces may be obtained from the study of binary mixtures. Density, refractiveindex,viscosities and ultrasonic velocity measurements of binary mixtures can be represented in term of excess functions. With the help of an ultrasonic interferometer we can determine various thermodynamic parameters like ultrasonic velocity, Adiabatic Compressibility (β_{ad}), Isentropic Compressibility(β), Isothermal Compressibility (β_T), Effective Debye Temperature (Q_D), Grunesian Parameters (T), Intermolecular Free Path length (L_f), Internal Pressure (π_i), free volume (V_f), Rao‟ s constant (R) , Surface Tension (S_t), Mean Square Thermodynamic Fluctuation, Vander Waal‟ s Constant (b), Wada Constant (W), Space Filling Factor (r) and Relative Association (R_a). With the help of these thermodynamic properties calculated with the help of ultrasonic interferometer, we can study phenomenon like azeotropism, intermolecular interactions, miscibility and compatibility of binary liquid mixture, phase transition between various phases, various thermodynamic properties of binary and ternary liquid mixture, transport related phenomenon and various properties related with transport phenomenon etc.

II. REVIEW OF LITERATURE

The equipment used for the investigations will be Pyknometer , dilatometer . Ultrasonic,interferometer, Abbe'srefractometer and Ubbelhode viscometer and all the experiments will be carried out in a digital constant temperature water bath maintained at a constant temperature of 298k electronically.The chemicals used will be ARgrade and further purified by using standard techniques and checked by spectroscopic methods.

III. MATERIAL AND METHOD

Intermolecular forces are due to charged, particles electrons and protons that make up an atom or molecule, Strong nuclear forces are responsible for binding the neutrons and protons inside the nucleus and are significant over a distance of 10^{-4} nm. Weak nuclear forces are of similar nature but are of short range, Further, these intermolecular forces also involve short range repulsion as well as long-range attraction. Various Contributions to the long-range force are due to i) electrostatic ii) induction and iii) dispersion contributions.

Short range forces arise when molecules approach each other sufficiently close enough to cause their electron clouds to overlap so that the Pauli's Exclusion Principle prohibits some electrons from occupying the overlap region thereby providing a nodal plane in this region. Although the short rang forces are usually repulsive, this is not always the case even in the case of closed shells. If it were so, chemical combination would have been impossible.

Some other important types of interactions between the components of mixtures are due to polar nature of components, hydrogen bonding and formation of associated complexes. Charge transfer interaction lead it formation of complexes between acceptor molecule and donor molecule. Whenever, the donor and acceptor molecules are in contact, contact change transfer interactions occur. Hydrogen bond is more strongly bound to one atom than the other atom. Generally, hydrogen bond formation is believed to involve three types of interactions viz. dipole-dipole, charge transfer and electron interactions it plays a major role in solvent-solute interactions in several cases.

Since equilibrium properties of a liquid and their mixtures strongly depend on the forces between the molecules and these forces vary with composition, knowledge of the potential energy of a group of molecules as a function of their actual separation and orientation should suffice to determine the macroscopic properties of a substance. The inverse problem of determining the potential energy from the experimental properties has also been widely studied but uncertainties in the experimental data usually lead to unreliable information. Consequently, generally a model is set up with or two or more adjustable parameters and one more physical property are calculated in terms of these Parameters and then compared with the experimental data.

IV. RESULT AND CONCLUSIONS

The following systems of binary liquid mixtures will be investigated to understand the various possible interactions present between the two components.

1. DMSO + CHLOROFORM
2. DMSO + ACETONE

3. DMSO + m-XYLENE
4. DMSO + CYCLO HEXANA

Density ,viscosity ,refractive index ,ultrasonic velocity measurement techniques will be employed for pure components and to determine excess functions of various compositions of all the above mentioned binary systems.

Deviation in physical properties in binary mixtures in comparison to that of pure components would give indication about the type of interactions taking place in different binary mixtures. Data generated will be analyzes using several models of interactions described by previous workers and parameters related to several types of interactions will be evaluated .it will be possible to explain the types and magnitude of interaction occurring between the two components of the systems investigated at their various compositions of the binary liquid mixtures.

Accordingly, the main objectives of our research paper are

A. To collect a set of new experimental data on various physicochemical properties such as density, excess volume, ultrasonic speed and viscosity for the different binary solvent system of above said non electrolytes, at 25 temperatures and composition range.
B. To evaluate various excess thermodynamic functions for the individual properties from the measured data on pure and binary liquid mixture components.
C. To examine the sensitivity of the composition dependence of the variety of thermodynamic properties to variations in temperature and size, shape and nature of the components from the graphical and analytic perspectives in order to understand the nature and extent patterns of molecular interactions that exist in binary liquid mixture of non-electrolytes.
D. To understand the recent various existing theories of solutions based on statistical with the experimentally derived properties to the binary liquid mixtures.
E. To understand the complex molecular interactions in the binary systems from the knowledge of corresponding experimental binary data
F. To develop models with for prediction of thermodynamic properties of such mixture.

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