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Comparative Study of Molecular Interaction in Binary Liquid Mixture At 303.15 K

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ABSTRACT:
In this paper, experimental measurement of viscosity, density and refractive index of a pure liquid and their binary mixture of compound m-cresol with methanol, ethanol, butanol, propanol and alcohols were done at a temperature of 303.15 K. The data analysis obtained above gave information about various parameters such as excess molar volume, viscosity deviation, internal pressure, excess free volume, compressibility, excess ultrasonic velocity , intermolecular free length etc. The result is discussed in terms of existence of intermolecular interactions between the components in the mixtures under the study.

KEYWORDS: Density, viscosity, refractive index, adiabatic compressibility, ultrasonic velocity.

INTRODUCTION:

Ultrasonic Velocity measurements have been employed extensively to detect and assess weak and strong molecular interactions in binary and tertiary mixtures because mixed solvents find practical applications in many chemical and industrial process. [1]

The main aim of this research is "Comparative Study of Molecular Interaction in Binary Liquid Mixture at 303.15 K.

There are various physical methods such as ultrasonic Velocity, viscosity, density and refractive index measurements to identify the strength of intermolecular interactions in the binary solutions. [2]

The ultrasonic method plays an important role in understanding the physico-chemical behaviour of liquids. The velocities give information about the bondding between the molecule and formation of complexes at various temperatures through molecular interaction. [3]

Density is defined as its weight per unit volume. A fundamental feature of matter, density indicates the amount of mass contained in a specific volume. It is a measrement of the density of particles inside a material. In many facets of science and daily existence, density is vital. It is crucial in disciplines including materials science, chemistry, and engineering. It also influences the behavior of fluids in fluid mechanics and helps determine whether an object will float or sink in a fluid (buoyancy). Greek scientist Archimedes made the discovery of the density principle.

Viscosity arises from the internal friction between molecules as they move past each other. In fluids, molecules are in constant motion, and their interactions determine the fluid's viscosity. This internal friction converts mechanical energy into heat, which is why fluids with higher viscosity tend to generate more heat when they flow.

There are two types of viscosity: dynamic viscosity and kinematic viscosity.
Dynamic viscosity (also known as absolute viscosity): This measures the resistance to flow under an applied force. It is denoted by the symbol "η" (eta) and is typically expressed in units such as Pascal-seconds (Pa·s) or poise (P).
Kinematic viscosity is calculated by dividing the dynamic viscosity by the density of the fluid. It shows the fluid's resistance to flowing in the absence of outside forces. The sign "v" (nu) represents kinematic viscosity, which is commonly stated in quantities like centistokes (cSt) or square meters per second (m2/s).
The amount that a light beam benfs when moving from one medium to another medium is measured by its refractive index. It can be expressed as-

$$n= c/v$$

The ratio of a light rays velocity in empty space to that of light in a matter.
The refractive index is dimensionless and is commonly denoted by the symbol n. It is a basic characteristic of materials that is influenced by atomic structure, density, and composition.
Refractive indices vary among materials and are influenced by temperature and wavelength, among other things. For instance, diamonds bend light more than air or water because of their high refractive index.

REVIEW ARTICLE:

R Kumar et al. Found that the extent of interaction existing between two components. In acetone-CCl4 system, the interaction parameter values have been out to be negative and in acetone-benzene system there are strong dipole induced -dipole interactions.

M Durga Bhavani et al. Found that some parameters like density, speed of sound, viscosity values are measured in binary mixtures containing O-anisidine and with O-cresol.

K Narendra et al. Found that density, viscosity and ultrasonic Velocity of binary liquid mixtures of Anisaldehyde with O-Cresol, m-cresol and p-cresol over the entire composition range have been measured at 303.15 K, 308.15 K, 313.15 K and 318.15 K.

D. Chinnarao et al. Found that density, ultrasonic velocity and dynamic viscosity for binary mixtures of Ethyl Oleate with Ethyl Methyl Ketone is experimented at ambient temperature ranging from 303.15 K to 318.15 K at atmospheric pressure.

N. Santhi et al. Found that the theroritical value of ultrasonic Velocity were evaluated using the Nomoto's relation, Ideal Mixture relation, Free length theory and Collision factor theory further the densities of binary mixtures of Dimethyl sulpohoxide with phenol, o-cresol, p-cresol and p-chlorophenol at 318.15 K were measured.

B. Nagarjun et al. Found that speed of sound and density for binary mixtures of ethyl benzoate with N,N-dimethylformamide, N,N-dimethyl acetamide, and N,N-dimethyl aniline were measured as a function of mole fraction at temperatures 303.15 K, 308.15 K, 313.15 K and 318.15 K and atmospheric pressure.

R. D. Pawar et al. Found that density, viscosity and ultrasonic Velocity of a binary mixtures of t-butyl alcohol, n-butyl alcohol and iso pentyl alcohol have been prepared with O-nitrotoluene at 303.15 K and 313.15 K. The data analysis of different parameters such as excess molar volume, viscosity derivation, deviation in isotropic compressibility etc. were done. The observed parameters and their changes are correlated to each other.

S. Bahadur Alisha et al. Found that density and ultrasonic velocity of binary liquid mixtures of trimethyl amine with carbitols, methyl carbitol, ethyl carbitol and butyl carbitol have been measured at 308.15 K. Various parameters such as isentropic compressibility, intermolecular free length and acoustic impedence

were calculated by the observed data. The results were discussed in terms of the existence of intermolecular interactions between the components in the liquid mixtures under the study.

Sk. Fakruddin et al. Found that measurements of the values of ultrasonic Velocity, viscosity, density in binary liquid mixtures of a heterocyclic aromatic compound quinoline which is readily soluble in organic solvents cresol at different temperatures over the entire range of composition. Different parameters such as adiabatic compressibility, excess intermolecular free length, excess ultrasonic Velocity were evaluated with the help of above calculated values.

CONCLUSION:

It has been found that various physical methods and parameters were measured and evaluated in order to identify the strength and study on intermolecular interactions in the binary liquid mixtures/ solutions.

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