Speeds of Sound and Isothermal Compressibility of Ternary Liquid Systems at 298.15 K: A Comparison with Theory

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The prime object of speeds of sound and density measurements in liquid systems is to estimate the value of isentropic compressibility (β_s), which cannot be done by any other method. Isentropic compressibility has been widely used to study the molecular interactions through its excess value. On the other hand, it can also be used to deduce other useful thermodynamic properties i.g. isothermal compressibility (β_T), heat capacity ratio (γ), internal pressure (P_i), cohesive energy density (CED) etc. Isothermal compressibility and heat capacity ratio are two key parameters in molecular thermodynamics of fluid phase equilibria. Flory's statistical theory and various hard sphere equations of state have already been applied to evaluate the values of isothermal compressibility (β_T), specific heat ratio (γ), and speeds of sound (u) of pure liquids and binary liquid mixtures under varying physical conditions.

In the present work, the result of experimental measurements of speeds of sound (u) and density (ρ) of three ternary liquid systems, namely, toluene + n-heptane + n-hexane(1), cyclohexane + n-heptane + n-hexane(2) and n-hexane + n-heptane + n-decane(3) are reported at 298.15 K and atmospheric pressure. Isothermal compressibility of these mixtures has been evaluated from measured values of density and speed of sound through an empirical method. The isothermal compressibility of these mixtures has also been evaluated using two different theoretical approaches; namely, Flory's statistical theory and hard sphere models. Theoretically computed values of isothermal compressibility have been compared with experimental findings. Superiority of Flory's Statistical Theory has been established quite reasonably over Hard Sphere Models. As far as, my knowledge goes, this is a novel theoretical approach for estimating isothermal compressibility of industrially important multi component systems of higher Alkanes.