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Prediction of Speeds of Sound in the Binary Mixtures of Ethyl Lactate with Cyclohexanone, Cyclohexylamine and Cyclohexanol at 303.15 K

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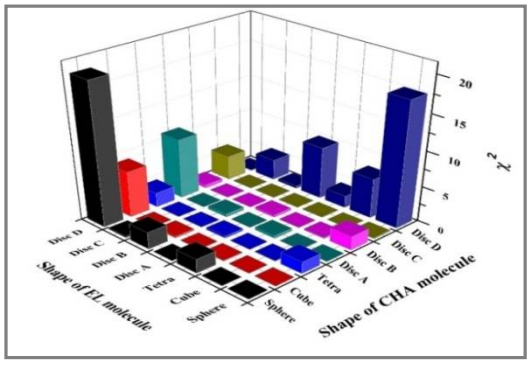
ABSTRACT

Densities and speeds of sound of binary mixtures of ethyl lactate with cyclohexanone, cyclohexylamine and cyclohexanol including those of pure liquids are measured over the entire composition range at temperature 303.15 K. A comparative study of experimentally measured and theoretically predicted speeds of sound at 303.15 K is made using different theories viz., Nomoto, impedance, Van Gael and Vangeel, Junjie, Rao and collision factor theories. Scaled particle and free length theories are applied to these mixtures by considering different shapes viz., sphere, cube, tetrahedron, disc A, disc B, disc C and disc D for both the participating components i.e., ethyl lactate with cyclohexanone, cyclohexylamine and cyclohexanol. From the experimental data, various thermodynamic parameters viz., molar volume, intermolecular free length and isentropic compressibility useful in the computation of theoretical speeds of sound in the mixtures are calculated. Chi-square test is applied for the goodness of the fit to investigate the relative applicability of these theories to the binary liquid mixtures under investigation by considering 196 combinations of different molecular shapes and thermodynamic states at 303.15 K and a close agreement is found between theoretically predicted speeds of sound and the experimental values.

Graphical Abstract



χ^2 values corresponding to different shape combinations
of ethyl lactate and cyclohexylamine molecules using scaled particle theory

Highlights

- Binary liquid mixtures of ethyl lactate + cyclohexanone, cyclohexylamine and +cyclohexanol are investigated
- Correlation between experimental and theoretical speeds of sound is made
- Shapes and thermodynamic states of the molecules are considered in scaled particle and free length theories
- Scaled particle theory accurately predicted the speeds of sound in the mixtures studied
- Statistical analysis is made by determining standard deviation and by applying Chi-square test

Keywords: Ultrasonics, Thermodynamic parameters, Scaled particle theory, *Chi*-square.