

Excess Gibbs Potentials of Hexanol or Cyclohexanol + Alkane Mixtures Using Rayleigh Light Scattering

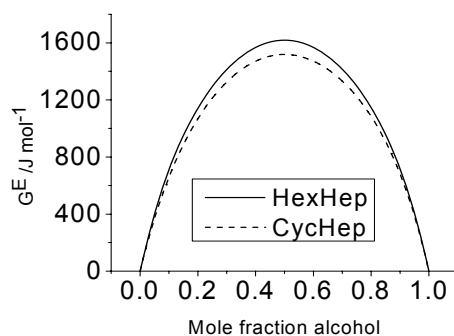
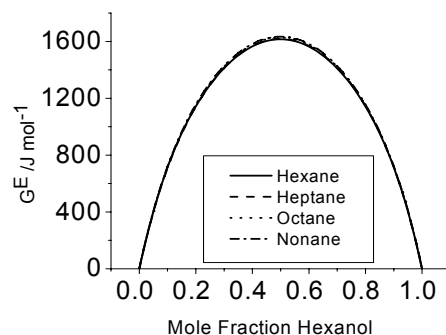
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Background. The existence of intermolecular interactions will affect the density and concentration fluctuations that affect the physical properties of any liquid. The intensity of scattered light is sensitive to the existence of such interactions.

The goal here is to probe the interactions that occur between polar and nonpolar molecules in the liquid phase. Selected binary liquid mixtures of an alcohol (polar) + an alkane (nonpolar) as functions of temperature and composition have provided insight into how small alcohols interact with small hydrocarbons. The mixtures studied were of normal hexanol or cyclohexanol mixed with hexane, heptane, octane, or nonane. The intent was to compare how linear alcohols and cyclic ones interact with compare short chain alkanes and longer chain alkanes. The mixtures were studied at 298, 308, and 318 K.

Methodology. Light scattering intensity measurements, density and refractive index measurements are made on the same solutions. In addition the viscosity of these mixtures have also been measured. Excess volumes, excess Gibbs potentials G^E , and viscosity deviations have been obtained from these measurements. G^E data contains the information on the intermolecular interactions.

Results. The above figure shows the G^E of hexanol+alkane at 298 K. The difference of G^E value between alkanes was small. As the chain length increased, G^E increases. Considering 5% error, the graphs overlap. The below figure shows the G^E of hexanol+heptane and cyclohexanol+heptane at 298 K. This comparison suggests how structural difference of the alcohol affected the results. Hexanol mixtures have higher G^E than cyclohexanol mixtures. Steric hindrance of cyclohexanol mixtures affected negatively to G^E . Hexanol+nonane show higher G^E due to shape of alcohols. All of the mixtures show G^E to increase with temperature. G^E of hexanol+alkane increases as chain length increases. G^E of cyclohexanol+alkane decreases as chain length increases except nonane.



$$R_{is} = R_d + R_c + R_{dc}$$

$$R_d = \left(\frac{\pi^2}{2\lambda^4} \right) k_B T \kappa_T \left[\frac{2n(n+0.4)(n^2-1)}{n^2+0.8n+1} \right]^2$$

$$R_{dc} = \left(\frac{\pi^2}{2\lambda^4} \right) k_B T \kappa_T x_2 (1-x_2) \left[\frac{2n(n+0.4)(n^2-1)}{n^2+0.8n+1} \right] \left(\frac{\partial n}{\partial x_2} \right)$$

$$R_{c,id} = \left(\frac{\pi^2}{2\lambda^4} \right) \left(\frac{Vx_2(1-x_2)}{N_A} \right) \left[4n^2 \left(\frac{\partial n}{\partial x_2} \right)^2 \right]$$

$$R_c = \left(\frac{\pi^2}{2\lambda^4} \right) k_B T V (1-x_2) \left[\frac{4n^2 \left(\frac{\partial n}{\partial x_2} \right)^2}{\left(\frac{\partial \mu_2}{\partial x_2} \right)} \right]$$

$$\left[\frac{R_{c,id} - R_c}{R_c} \right] = \frac{x_2(1-x_2)}{N_A k_B T} \left(\frac{\partial^2 G^E}{\partial x_2^2} \right)$$

$$G^E = x_2(1-x_2) \sum_{j=1}^n A_j (1-2x_2)^{(j-1)}$$

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