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Sustainable Hydrophobic Terpene-Terpene Eutectic Mixtures

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PURPOSE OF THE ABSTRACT

Nowadays, developments in engineering and technology are strongly influenced by the concepts of green chemistry and sustainability. Within this framework, there is a demand for new eco-friendly solvents able to dissolve a large spectrum of solutes. Currently, one of the most important focus of research for novel solvents are eutectic mixtures, and particularly the so-called deep eutectic solvents (DES). Most of the DES proposed so far were prepared through the combination of materials from renewable resources with nontoxic and biodegradable compounds such as carboxylic acids, polyols, and sugars; being the vast majority hydrophilic [1-5]. To the best of our knowledge, only a limited number of works reported hydrophobic eutectic mixtures [6-11]. In general, however, the solid-liquid equilibria (SLE) phase diagrams of these mixtures were not characterized despite the relevant information that they can provide on the range of composition and temperature for operating these systems. Moreover, a broader physicochemical characterization of their properties is also poor.

Due to their very low solubility in water, and relatively low price, terpenes appeared as good candidates to prepare sustainable and cheap hydrophobic solvents. Menthol, thymol, camphor, sobrerol and borneol are monoterpenoids used in various industrial processes and commercial products.

Thus, the main goal of this work is to prepare and characterize eutectic mixtures composed by the above mentioned monoterpenoids. The SLE phase diagrams of these mixtures were measured in the whole composition range, through differential scanning calorimetry, and represented by COSMO-RS. At room temperature, liquid solvents can be obtained for many of these mixtures, on a wide composition range, not fixed to any particular stoichiometric relationship between the hydrogen bond donor and acceptor, even at the eutectic point, what reinforces the tunable character of the liquid phase region of these mixtures. The experimental SLE phase diagrams were successfully described using the predictive thermodynamic model COSMO-RS. Moreover, the densities, viscosities, mutual water solubilities and solvatochromic parameters were measured for mixture compositions close to the eutectic one.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Terpenes | Hydrophobic | Eutectic Mixtures | COSMO-RS

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