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Tetrathiocyanatocobaltate and bis(trifluoromethylsulfonyl)imide-based ionic liquids as mass agents in the separation of cyclohexane and cyclohexene mixtures by homogeneous extractive distillation

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ABSTRACT

In this work, the suitability of two tetrathiocyanatocobaltate-based ionic liquids, namely bis(1-ethyl-3-methylimidazolium) tetrathiocyanatocobaltate ($[emim]_2[Co(SCN)_4]$) and bis(1-butyl-3-methylimidazolium) tetrathiocyanatocobaltate ($[bmim]_2[Co(SCN)_4]$), and two bis(trifluoromethylsulfonyl)imide-based ionic liquids, namely 1-ethyl-4-methylpyridinium bis(trifluoromethylsulfonyl)imide ([4empy][Tf_2N]) and 1-butyl-4-methylpyridinium bis(trifluoromethylsulfonyl)imide ([4bmpy][Tf_2N]), as mass separating agents to separate cyclohexane and cyclohexene mixtures by homogeneous extractive distillation was analysed. Isothermal vapour-liquid equilibria (VLE) for the binary systems {cyclohexane or cyclohexene + ionic liquid} and the ternary systems {cyclohexane + cyclohexene + ionic liquid} were determined at 323.2, 363.2 and 403.2 K by headspace-gas chromatography (HS-GC). All the ternary systems were studied with a solvent-to-feed ratio on mass basis of 10. In addition, solvent-to-feed ratios on mass basis of 8 and 6 were evaluated for the ternary systems containing [Tf_2N]-based ionic liquids. The Non-Random Two Liquids (NRTL) model was used to describe the experimental VLE data accurately. The values of cyclohexane/cyclohexene relative volatilities provided by the four ionic liquids enhanced those obtained with conventional mass agents such as ethylene glycol. The highest relative volatilities were obtained with the $[Co(SCN)_4]$-based ionic liquids. However, taking into account the viscosity and thermal stability of the four ionic liquids studied here, the [4empy][Tf_2N] was considered the most promising alternative from an extractive distillation approach.

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