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Separation of aromatics and aliphatics using deep eutectic solvents

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The separation of (sulfur-containing) aromatic and aliphatic compounds is of crucial importance in the petrochemical business. Industrially, the sulfolane process is used forthis separation. The sulfolane process implies liquid-liquid extraction using sulfolane as extracting agent followed by distillation for the sulfolane recovery. The main disadvantages of the sulfolane process are the usage of a volatile, flammable and toxic extracting agent together with the enormous energy requirements needed for the solvent recoverystep.

In order to develop a more sustainable and cost-effective process, several novel solvents have been studied as alternative to sulfolane. Ionic liquids (ILs) have been widely investigated for the separation of aliphatic-aromatic mixtures via liquid-liquid extraction. However, the high price of ILs, associated mainly to the complicated synthesis and purification, istheir main drawback for large scale application. Contrarily, deep eutectic solvents (DESs), which are ILs analogues interms of properties, can be prepared cheaply, with low price starting materials and without purification requirements, overcoming the main disadvantage of ILs. DESs are a mixture of one hydrogen bond donor (HBD) and one hydrogenbond acceptor (HBA), generally solids, that when mixed in the proper ratio, show a large decrease in the melting pointcompared to the initial compounds. In the last years, the scientific community has started to explore the applicability ofthis new generation of green solvents as extracting agents in liquid-liquid extraction, mainly for the separation of aliphatic-aromatic mixtures.

In this work, several new DESs have been tested as extracting agents for the separation of various aliphatic-aromatic mixtures. The liquid-liquid equilibrium (LLE) of the ternary mixtures {hexane + benzene + DES} and {hexane + thiophene + DES} and have been measured at atmospheric pressure. The solute distribution coefficient and the selectivity have been calculated and compared to literature. The effect of the temperature and composition (e.g. chainlength) has been studied. Moreover, the solvents have satisfactorily been recovered. The obtained experimental resultsshow that DESs are promising extracting agents for the separation of aromatic components from aliphatic-aromaticmixtures. An economic evaluation of the sulfolane process compared to the process using ILs and DESs will be alsopresented.

Biography:

Maaike Kroon (1980) obtained her MSc (2004) and PhD (2006) in Chemical Engineering from TU Delft, Netherlands. She was awarded the prize for best graduate student and the DSM Science & Technology Award. Thereafter, she worked as Assistant Professor at TU Delft, MATGAS research center in Spain and Stanford University in USA. In 2011 she was appointed Full Professor at Eindhoven University of Technology as the youngest female professor in The Netherlands. In 2015 she was awarded the Science Talent Award of the year by the journal New Scientist. Maaike Kroon joined the Petroleum Institute in Abu Dhabi as a Professor in Applied Thermodynamics and Separation Technology in 2016. Her research focuses on the development of novel energy-efficient affinity separation processes (e.g., aromatic/aliphatic separation, gas sweetening, azeotrope breaking, and desalination) on basis of phase behavior.