

Denitrification Diesel Hydrocarbons Using Triethanolamine-Glycerol Deep Eutectic Solvent

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Abstract : The manufacture and marketing of the gasoline and diesel without aromatic compounds, particularly nitrogen heteroaromatics and sulfur heteroaromatics, is the main objective of researchers and the petrochemical industry to reply to the requirements of the environmental protection. This work is part of this line of research and for this a triethanolamine/glycerol (TEoA:Gly) deep eutectic solvent (DES), was used to remove two model nitrogen compounds, pyridine and quinoline from n-decane. Experimentally two liquid-liquid equilibrium systems {n-decane + pyridine/quinoline + DES} were measured at 298.15 K and 1.01 bar using the equilibrium cell method. This study aims to evaluate the potential of this DES as sustainable alternative to organic solvents for the denitrogenation of petroleum feedstocks by liquid-liquid extraction. Experimentally, the DES were prepared by the heating method. Accurately weighed triethanolamine as hydrogen bond acceptor (HBA) and glycerol as hydrogen bond donor (HBD), were placed in a round-bottomed flask. An Ohaus Adventurer balance with a precision of ± 0.0001 g was used for weighing the HBA and HBD. The mixtures were then stirred and heated at 343.15 K under atmospheric pressure using a rotary evaporator. The preparation was completed when a clear and homogeneous liquid was obtained. To evaluate the equilibrium behaviour of pseudo-ternary systems {n-decane + pyridine or quinoline + DES}, mixtures were prepared with the nitrogenous compound (pyridine or quinoline) at varying mass percentages in the n-decane, along with a fixed (2:1) ratio between the n-decane and DES phases. Defined amounts of these three components were precisely weighed to achieve mixtures within the biphasic region before vigorous stirring at 400 rpm using an Avantor VWR KS 4000 agitator shaker for 4 hours at 298.15 K, followed by overnight settling to attain thermodynamic equilibrium evidenced by phase separation. Aliquot from the upper phase rich in n-decane and the lower phase rich in DES were carefully weighed. The mass of each sample was precisely recorded for quantification by gas chromatography. The DES content was calculated by mass balance after analysing the composition of the other species such as n-decane, pyridine or quinoline. All samples were diluted with pure ethanol before their analysis by GC. Distribution ratios and selectivities toward pyridine and quinoline compounds were also measured at the same phase molar ratios. The consistency and reliability of the experimental data, were verified and validated by the Othmer-Tobias and Batchman correlations. The experimental results show that the highest value of the partition coefficient $\beta=7.08$ was obtained with pyridine extraction and the highest selectivity $S=801.4$ was obtained with quinoline extraction. The experimental liquid-liquid equilibrium data of these ternary systems were correlated by using the Non Random Two-Liquids (NRTL) and Conductor-like Screening Model for Real Solvents (COSMO-RS) models. A good agreement with the experimental data was observed with NRTL and COSMO-RS models for the two systems. The performance of this DES was compared to those of ionic liquids and organic solvents reported in the literature.

Keywords : piridyne, quinoline, n-decane, deep eutectic solvent

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