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Recovery of Metallic Ions from Natural Resources with Aqueous Two-Phase System Containing Environmentally Friendly Solvent

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Summary

Use of an environmentally friendly solvent and extractant categorized as green solvent in the aqueous two-phase extraction and solvent extraction from natural resources is a manner to bring the green chemistry to reality.

First, we examined the extraction of Co (II) with aqueous two-phase system formed by ionic liquid 1-hexylquinolinium bromide and sodium chloride. Aqueous two-phase system was successfully formed and the quantitative extraction of Co (II) with this extraction system was achieved. Secondly, we examined the extraction of Fe (III) and Mn (II) with aqueous two-phase system formed by ionic liquid 1-hexyl-3-methylimidazolium dodecylsulfonate and polyethylene glycol (PEG). The extractability increased with increasing HCl and ionic liquid concnetrations. It was confirmed that the amount of extracted Fe (III) corresponded to the the amount of released sulfur, suggesting the anion exchanged extraction. This extraction system gave a poor extractive selectivity of Fe (III) and Mn (II).

Finally, we used deep eutectic solvent (DES) composed of decanoic acid and lidocaine which has characteristic as green extractant for separation of Fe (III), which is the most used metal in the world, and Mn (II), which currently being used in many industries. We found that the pH of the initial metal solution strongly influenced the extraction mechanism. Fe (III) can be extracted at pH 1.0 to 2.0 due to the ion pair reaction between Fe^{3+} and decanoic anion, while at the higher pH the extraction mechanism cannot be evaluated due to the formation of precipitation at the aqueous phase. In the case of Mn (II), the ion pair reaction was occurred at the pH of lower than 2.2 and higher than 3.5, while from pH 2.2 to 3.5, the cation exchange between Mn^{2+} and lidocaine cation probably dominated the extraction process. The DES concentration needed to reach the complete separation of Fe (III) was about 25 g/L while Mn (II) was completely extracted using about 300 g/L of DES. The selectivity with this method was very high when was applied in the separation of Fe (III) from Mn (II).