Separation of iron, zinc and lead from a choline chloride:ethylene glycol deep eutectic solvent by solvent extraction

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In order to reduce the depletion of primary mining sources, secondary sources such as industrial waste streams can be processed. Although the metal concentrations in these wastes are often low, the involved volumes are sufficiently large to secure a secondary source with a metal variety. The recovery of iron(III), zinc(II) and lead(II) is potentially relevant because these metals are common elements in various types of metallurgical wastes. This topic uses deep eutectic solvents (DESs) as an alternative aqueous phase in solvent extraction (SX), introducing the term "non-aqueous SX". The selective extraction of iron(III) and zinc(II) was studied from a feed of Ethaline 200 (1:2 molar ratio of choline chloride:ethylene glycol, ChCl:EG). A commercial mixture of trialkylphosphine oxides (Cyanex 923, C923) diluted in an aliphatic diluent selectively extracted iron(III) from a feed containing also zinc(II) and lead(II). The subsequent separation of zinc(II) from lead(II) was carried out using the commercially available basic extractant Aliquat 336 (A336). The equilibration time and the extractant concentration were optimized for both systems. Iron(III) and zinc(II) were stripped using 1.2 mol L^{-1} oxalic acid and 0.5 mol L^{-1} aqueous ammonia, respectively. An efficient solvometallurgical flowsheet is proposed for the separation and recovery of iron(III), lead(II) and zinc(II) from Ethaline 200 using commercial extractants. Moreover, process upscaling was demonstrated in a countercurrent set-up by using mixer-settler equipment resulting in successful separation and purification.

Keywords: Solvometallurgy; deep eutectic solvents; end-of-life products recycling, mixer-settlers.

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