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Separation of rare earths by a sustainable process with solvometallurgy using PEG 200 and Cyanex 923

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PURPOSE OF THE ABSTRACT

Rare-earth elements (REEs) are the key components in many green and sustainable energy technologies such as permanent magnets, batteries and lamp phosphors. There is a growing interest in reclaiming these REEs from end-of-life products due to the great demand and supply risk. Hydrometallurgy, employing aqueous solutions is a widely used method for industrial separation of REEs. Recently, solvometallurgy, employing non-aqueous solutions, emerges as a new branch of extractive metallurgy.1 However, both branches have few intrinsic limitations. Hydrometallurgy consumes large amounts of acids and bases and generates large volumes of aqueous waste streams. On the other hand, solvometallurgy has issues with potential non-aqueous (green) solvents capable of leaching metal oxides and alloys and the mutual solubility of two immiscible organic phases in the downstream processing. In order to retain the advantages of both methods, it is necessary to bridge the gap between hydrometallurgy and solvometallurgy. Therefore, a mixture of water-miscible non-aqueous green solvent and aqueous solution was selected as the solvent system. Poly(ethylene glycol) 200 (PEG 200) is a green, renewable, environmentally benign and biodegradable solvent.2 A solution of 70?80 vol% of PEG 200 in water was used as a more polar phase in non-aqueous solvent extraction. In this work, we developed a sustainable process for the separation of Dy and Nd by a solvometallurgical approach using PEG 200 and Cyanex 923. The process parameters studied were the water content in the more polar phase, the concentration of Cyanex 923, the concentration of LiCl and the volume phase ratio. The results indicated 100% extraction from pure PEG 200 and 0% extraction from pure aqueous solutions for both Dy and Nd, showing that the Dy/Nd separation is not possible by solvent extraction from these feed solutions. On the contrary, high separation factors were found for extraction from PEG 200-water mixtures. Based on the results, a conceptual process flow sheet for the separation of Dy and Nd is proposed.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Solvometallurgy | Rare earth elements | Sustainable process | PEG 200

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