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## Recovery of Rare Earth Elements from Coal-Based Waste Streams

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**Abstract** Coal-related waste streams are known to be enriched in technology critical metals such as rare earth elements (REE, herein defined as the 14 stable lanthanides, yttrium and scandium). These wastes include combustion residues such as coal fly ash and acidic mine drainage from mine waste piles. This presentation will describe characteristics of these waste streams in the context of their potential as resources for REEs. The recovery potential of REE from these wastes not only depend on the concentration of REEs, but also depend on the chemical forms of the desired metals in residuals and their extractability. The presence of impurities in extracts of these waste are critical for the efficiency of subsequent purification processes such as solvent exchange. This presentation will also describe the application of supported liquid membranes (SLM), an approach that is similar to solvent exchange processes except that the REE-chelating organic phase is embedded in a hydrophobic membrane. This membrane acts as a cation exchange 'filter' to selectively partition REE ions from the feed solution on one side of the membrane into the acid stripping solution on the other side of the membrane. A potential advantage of the SLM process is that it requires much less volume of hazardous organic solvents than the conventional approach and could be implemented in a modular system. Experimental testing of SLM separations for acid leachates of coal combustion residues and acid mine drainage demonstrate that separation fluxes are strongly dependent on the composition of the feedstock matrix, including the pH and soluble iron concentration. Altogether, this work demonstrates the promise and technical challenges of coal-based waste streams as an alternative resource for REEs.

**Keyword(s)**

Resource recovery, Technology critical metals, Waste reuse

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