

Potential of Alkylamine Dicarboxylic Acids as REE Ion Capture Chelators

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Structured Abstract

Background: Rare earth elements (REEs) are 17 chemically similar elements in the periodic table, consisting of 15 lanthanides, scandium, and yttrium. REE ion capture involves selectively extracting ions from sources such as wastewater, industrial by-products, or natural ores. Chelators are substances that form thermodynamically stable, water-soluble complexes with metal ions via chelation and can selectively coordinate to REE particles, facilitating recycling. The development of REE ion capture is crucial for modern technologies, as it reduces mining demand and increases the recovery and quality of REEs. Alkylamine Dicarboxylic acids, which contain an amine group and carboxyl fragments, are promising chelating agents for REE ion capture due to their selective complexing capabilities.

Methods: These acids are biodegradable, require less toxic solvents, and can be used at lower pH levels and temperatures, making them less environmentally damaging than other extraction processes. The use of alkylamine dicarboxylic acids for capturing REE ions faces challenges in recovery, cost, and environmental compatibility. Re-leaching may be destructive, increasing operation costs and diminishing chelation-desorption cycles.

Results: HEIDA is a chelating agent used for recovering rare earth elements (REEs) due to its structural and functional properties. Its tridentate ligand geometry allows it to form stable complexes with REEs, allowing for further optimization under controlled conditions. Despite its low chelating strength, HEIDA facilitates stable complex formation without hindering desorption, making it suitable for ion-exchange chromatography. It is less environmentally damaging than stronger chelating agents such as DTPA and is less bioaccumulative.

Conclusion: In summary, HEIDA has demonstrated strong potential as a rare earth element (REE) chelator under laboratory conditions, forming stable complexes and enabling effective separation with high purity. However, challenges such as low synthesis yields, byproduct formation, limited data on long-term reusability, and unclear environmental impact hinder its commercial scalability. While HEIDA addresses key scientific criteria, it falls short in meeting broader industrial requirements for sustainable and practical REE recovery.

Keywords: Rare earth element, alkylamine dicarboxylic acids, HEIDA, chelating

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