Evaluation of Hydrometallurgical Methods for Designing Rare Earth Elements Recovery Plant

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Abstract:

Due to the high demand for rare earth elements (REEs), recovering these elements from end-of-life NdFeB magnets has attracted considerable attention over the last decade. Consequently, the INSPIREE project was introduced to recover REEs on an industrial scale through hydrometallurgical processes from secondary resources. This research assessed the effectiveness of various hydrometallurgical methods to determine the most efficient approach. Given the priority of using organic acids in this project, NdFeB magnets were leached with citric acid. Additionally, solvent extraction and precipitation processes were applied to recover REEs. The investigated methods included: I) applying a solvent extraction stage to extract REEs, followed by stripping precipitation with phosphoric acid and conversion to REE oxalate using an oxalic acid solution; II) a similar extraction process to method I, but with stripping precipitation using an oxalic acid solution; and III) precipitating REEs directly with sodium carbonate to produce REE-carbonate. The results indicated that: 1) the oxide products obtained by methods I, II, and III contained

96.8, 95.3, and 73.3% REEO, respectively; 2) Method II offered the advantage of eliminating the conversion stage compared to method I while also enabling the recovery of heavy REEs; 3) Method III demonstrated a straightforward process with low operating costs; and 4) the iron concentration in the final product was approximately 0.1% for methods I and II, and 1-2% for Method III. The findings from this investigation highlight the significant potential of hydrometallurgical methods in recycling NdFeB magnets. Furthermore, they can be a pivotal reference for selecting the optimal method to design the INSPIREE plant.

Keywords: NdFeB magnet; Recycling; Hydrometallurgical plant; Rare earth elements; Sustainable development.