SEPARATION SCIENCE AND TECHNOLOGY
2026, VOL. 61, NO. 1, 68–79
https://doi.org/10.1080/01496395.2025.2591163

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Effects of saponification and synergism on the solvent extraction of rare earth elements from a sulfate leach solution of a low-grade titaniferous magnetite ore

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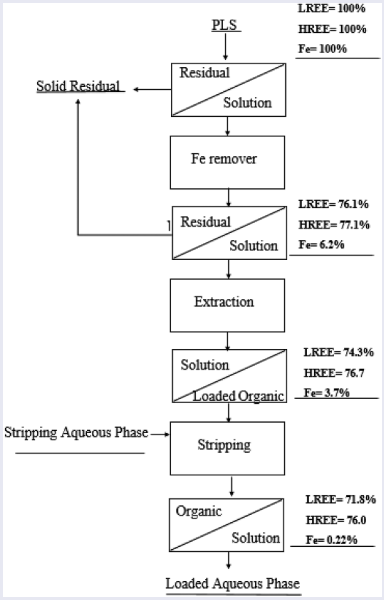
ABSTRACT

The recovery of rare earth elements (REEs) from low-grade titaniferous magnetite ores is important from economic and environmental point of views. The solvent extraction of REEs from the pregnant leaching solution (PLS) of a low-grade titaniferous magnetite ore was investigated. Ammonium jarosite precipitation process was firstly used to remove iron from the sulfate leach solution (93.7% removal at 95°C). The solution was then subjected to solvent extraction by Di-(2-Ethyl Hexyl) phosphoric acid (D2EHPA) and the results showed that maximum extraction (99.9% for heavy REEs and 98.2% for light REEs) was achieved at the D2EHPA concentration of 15% (v/v), the solution pH of 3, contact time of 5 min, organic: aqueous (O:A) phase ratio of 1:1 at 400 rpm. Furthermore, the effect of saponification on the extraction efficiency of LREEs in the presence of 2-Ethylhexyl 2-ethylhexyphosphonic acid (PC88A) was investigated. It was found that at the extractant concentration of 12% (v/v), 10% saponification leads to increase the LREEs extraction from 71.4% to 94.4%. Besides, the stripping experiments showed that the order of back extraction of REEs decreased in the series H_2SO_4> HNO_3>HCl. Furthermore, the selective separation was obtained for HREEs (40.1%) and LREEs (99.8%) with tributyl phosphate (TBP), and multi-stage solvent extraction was required to separate REEs from each other.



ARTICLE HISTORY
Received 5 March 2025
Accepted 12 November 2025

KEYWORDS
Rare earth elements; sulfate leaching; jarosite precipitation; solvent extraction; saponification

Introduction

Rare earth elements (REEs) are utilized in various strategic fields, including the production of catalysts, electronic devices, alloys and magnets due to their unique chemical and physical properties. The primary resources of REEs are bastnasite, monazite, and xenotime minerals.[1–4] REEs are categorized into light elements (La-Sm) and heavy elements (Eu-Lu). Separating REEs from each other is a significant challenge during their processing stages due to their highly similar physicochemical characteristics.[5] Various separation methods, such as solvent extraction, ion exchange, and precipitation, are widely employed to

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