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PII: S1350-4177(17)30424-8
DOI: http://dx.doi.org/10.1016/j.ultsonch.2017.09.028
Reference: ULTSON 3876

To appear in: *Ultrasonics Sonochemistry*

Received Date: 26 June 2017
Revised Date: 29 August 2017
Accepted Date: 15 September 2017

Please cite this article as: S. Yin, J. Pei, F. Jiang, S. Li, J. Peng, L. Zhang, S. Ju, C. Srinivasakannan, Ultrasound-assisted leaching of rare earths from the weathered crust elution-deposited ore using magnesium sulfate without ammonia-nitrogen pollution, *Ultrasonics Sonochemistry* (2017), doi: http://dx.doi.org/10.1016/j.ultsonch.2017.09.028

Ultrasound-assisted leaching of rare earths from the weathered crust elution-deposited ore using magnesium sulfate without ammonia-nitrogen pollution

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Abstract: The in-situ leaching process of China's unique ion-adsorption rare earth ores has caused severe environmental damages due to the use of $(NH_4)_2SO_4$ solution. This study reports that magnesium sulfate ($MgSO_4$) as a leaching agent would replace $(NH_4)_2SO_4$ by ultrasonically assisted leaching to deal with the ammonia-nitrogen pollution problem and enhance leaching process. At leaching conditions of 3 wt.% $MgSO_4$ concentration, 3:1 L/S ratio and 30 min, the total rare earth leaching efficiency reaches 75.5%. Ultrasound-assisted leaching experiments show that the leaching efficiency of rare earths is substantially increased by introducing ultrasound, and nearly completely leached out after two stage leaching process. Thus, ultrasonic-assisted leaching process with $MgSO_4$ is not only effective but also environmentally friendly, and beneficial to leach rare earths at laboratory scale.

Keywords: Rare earths; Leaching; $MgSO_4$; Ultrasound leaching

1. Introduction

As a unique mineral resource, the weathered crust elution-deposited rare earth ore can only be existed in some areas of China, mainly located in Guangxi, Guangdong, Yunnan, Hunan, Jiangxi, and Fujian provinces, which is the major resource of mid-heavy rare earths (REs) [1,2]. For example, the U.S. Department of Energy reports that five rare earth elements (Y, Nd, Eu, Tb, and Dy) are the most essential in the medium term (2015–2025) of clean energy technology deployment; while all of these elements are middle and heavy rare earths except for Nd [3]. So making full of the rare earths resources including low-grade ores to produce the mid-heavy rare