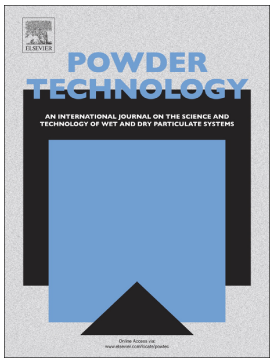

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Response surface method for optimization of leaching of a low-grade ionic rare earth ore

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ABSTRACT

China's ionic rare earth ore is of great strategic value because of its abundant medium and heavy rare earth elements (REEs). However, its rare earth reserves have decreased significantly in recent years. It is imperative to improve the utilization rate of existing rare earth mineral resources. In this study, a low-grade ionic rare earth ore was taken as the object of research. The relationships between pH value, concentration, and flow velocity of ammonium sulfate and leaching rate of REEs were studied by the response surface method (RSM) based on the central composite design (CCD) principle. A quadratic polynomial mathematical model for studying the leaching rate was established, and the leaching conditions were optimized.

The results showed that the pH value, concentration, and flow velocity had significant influences on the leaching rate and that the interaction between the pH value and concentration and that between the pH value and flow velocity also had significant effects on it. The optimal leaching conditions obtained by RSM optimization were a pH value, concentration, and flow velocity of 4.80, 5%, and 0.73 mL/min, respectively. The leaching rate under the optimal conditions was 97.10%, with a relative error of 0.705% to predicted value of the model, which shows that the obtained model has good predictive performance and has a certain guiding significance for the production practice of the ionic rare earth ore. The research results provide a scientific and stable basis for the production of this type of low-grade ionic rare earth ore by in situ leaching and also help to improve the resource utilization ratio.

Key words: Ionic rare earth ore; leaching; response surface method; process optimization

1. Introduction

Rare earths, known as the "industrial aginomoto," "industrial vitamin," and "mother of new materials," are used widely in many fields and more than 40 industries, and the medium and heavy rare earths are especially important as

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