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Uptake properties of Eu(III) on Na-attapulgite as a function of pH, ionic strength and temperature

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作者

Wang Mingming[1], Xie Hongqin[2], Tan Liqiang[3], Qiu Jun[1], Tao Xingquan[1], Wu Cuiping[1]

[1]Institute of Radiation Medicine, Anhui Medical University, Meishan Road 81, Hefei, 230032 Anhui, China
[2]Environmental Monitoring Station of Dongguan City, Tiyu Road 15, Dongguan, Guangdong Province, 523009 China
[3]Department of Chemical Engineering, Key Laboratory for Attapulgite Science and Applied Technology of Jiangsu Province, Huaiyin Institute of Technology, Huaian, 223003 People's Republic of China

摘要

Abstract
Herein, the sorption properties of Eu(III) on Na-attapulgite were performed by using batch sorption experiments under different experimental conditions, such as contact time, pH, ionic strength, humic acid and temperatures. The results indicated that the sorption of Eu (III) on Na-attapulgite was strongly dependent on pH and temperature. At low pH values, the sorption of Eu(III) was influenced by ionic strength, whereas the sorption was not affected by ionic strength at high pH values. The sorption of Eu(III) was mainly dominated by ion exchange or outer-sphere surface complexation at low pH values, and by inner-sphere surface complexation or surface precipitation at high pH values. The sorption of Eu (III) onto Na-attapulgite increased with increasing temperature. The Langmuir and Freundlich models were applied to simulate the sorption isotherms, and the results indicated that the Langmuir model simulated the sorption isotherms better than the Freundlich model. The thermodynamic parameters (ΔG^{o}, ΔS^{o}, ΔH^{o}) were calculated from the temperature dependent sorption isotherms at 293, 313 and 333 K, respectively, and the results indicated that the uptake of Eu(III) on Na-attapulgite was an endothermic and spontaneous process. The results of high Eu(III) sorption capacity on Na-attapulgite suggest that the attapulgite is a suitable material for the preconcentration and immobilization of Eu(III) ions from large volumes of aqueous solutions.

Keywords

Eu(III), Sorption, Na-attapulgite, pH, Ionic strength, Thermodynamic data

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Keywords Eu(III) · Sorption · Na-attapulgite · pH · Ionic strength · Thermodynamic data

W. Mingming (✉) · Q. Jun · T. Xingquan · W. Cuiping
Institute of Radiation Medicine, Anhui Medical University, Meishan Road 81, Hefei 230032, Anhui, China
e-mail: wangmm7216@163.com

X. Hongqin
Environmental Monitoring Station of Dongguan City, Tiyu Road 15, Dongguan, Guangdong Province 523009, China

T. Liqiang
Department of Chemical Engineering, Key Laboratory for Attapulgite Science and Applied Technology of Jiangsu Province, Huaiyin Institute of Technology, Huaian 223003, People's Republic of China

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Introduction

The understanding of physicochemical behavior of long-lived lanthanides and actinides in the environment is crucial to evaluate their potential pollution and human healthy [1–7]. In the last decade, the interactions of radionuclides with clay minerals and oxides have been studied extensively [8–14]. The sorption of the long-lived radionuclides is important for the assessment of nuclear waste repository at the solid-water interface. Europium belongs to the lanthanide group and only the trivalent oxidation state is stable in water [15, 16]. The ionic radii of Eu(III) is almost the same for all the trivalent lanthanides and actinides, which results in the similar chemical properties of Eu(III) as compared with other trivalent lanthanides and actinides [17]. In recent years, sorption of Eu(III) on hydrous metal-oxides and clay minerals has been studied extensively [18–26]. Takahashi et al. [27] studied Eu(III) sorption on non-porous silica and found that the inner-sphere complex of Eu(III) with silanol groups at the silica surface was the main sorption mechanism of Eu(III) uptake. Tan et al. [1, 4] studied the sorption of Eu(III) onto TiO_2, and found that the presence of fulvic acid (FA) strongly enhanced the sorption of Eu(III) onto TiO_2 at low pH values, and the sorption was attributed to inner-sphere surface complexation. The extended X-ray

Akadémiai Kiadó
H-1519 Budapest, Pf. 245
Telephone: +36-1-464-8222
email: journals@akkrt.hu

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