Study on Removal Effect and Mechanism of Uranium by Hydroxyapatite and Natural Apatite

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Abstract
By the static experiments, the effects of reaction time, pH value, initial concentration of uranium, dosage of apatite on adsorption of hydroxyapatite and natural apatite for uranium were studied respectively. The adsorption process was analyzed by thermodynamics and kinetics, and the adsorption mechanism was analyzed by infrared spectroscopy, X-ray diffraction and scanning electron microscope. The results of hydroxyapatite show that the removal capacity of uranium increases with the initial concentration of uranium, and the adsorption rate of hydroxyapatite on UO\textsubscript{2}\textsuperscript{2+} reaches 85%, when the pH value is 4 to 5 and dosage of hydroxyapatite is 0.75 g. The results of natural apatite show that the removal capacity of uranium increases with the initial concentration of uranium, and the adsorption rate of natural apatite on UO\textsubscript{2}\textsuperscript{2+} is up to 80%, when the pH value is 3 and dosage of hydroxyapatite is 1.0 g. Similarly, at 120 minutes both of the removal reactions by hydroxyapatite and natural apatite substantially reach equilibrium. Moreover, both of the reactions by hydroxyapatite and natural apatite are in line with quasi secondary dynamics equation, and follow the Langmuir adsorption isotherm. Infrared spectra indicate that the removal of hydroxyapatite for uranium depends on the complexation of phosphate, which is almost the same as that of natural apatite. X-ray diffraction analysis shows that hydroxyapatite has the composition and structure of pure material, whereas the natural apatite is mainly composed of Ca\textsubscript{5}H\textsubscript{2}(PO\textsubscript{4})\textsubscript{3}F and Ca\textsubscript{8}H\textsubscript{2}(PO\textsubscript{4})\textsubscript{6}H\textsubscript{2}O. In addition, scanning electron microscope demonstrates that hydroxyapatite has the appearance of spherical with a hole and the hole has a cavity containing a large amount of floc, while the surface becomes smooth and pores are closed after removal of uranium, which is due to the adsorption of UO\textsubscript{2}\textsuperscript{2+} leading a link between molecules on hydroxyapatite surface. But for natural apatite, it depicts the angular mineral shape before and after the removal of uranium, which means that UO\textsubscript{2}\textsuperscript{2+} is adsorbed on the natural apatite and the mineral crystal is formed.

Key words: Hydroxyapatite; natural apatite; uranium; thermodynamics; kinetics
References


