Cs^+, Sr^{2+} and Co^{2+} uptake in metakaolin-based geopolymer

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Abstract (approx. 55words)
In this study, the interaction of Cs^+, Sr^{2+} and Co^{2+} with Na/K-geopolymer is investigated. The geopolymer samples with the composition of SiO_2/K_2O: Al_2O_3/K_2O: H_2O/K_2O = 1:1:11 (where K: Na or K) were synthesized, and the surface electrostatic characteristics of the geopolymer is examined by zeta potential measurement. The dominant mechanism for ionic uptake is identified.
Keywords: Adsorption, ionic exchange, zeta potential, geochemical model

1. Introduction

The geopolymers are amorphous inorganic gel formed from the tetrahedrally coordinated aluminium and silicon atoms bridging with oxygen. The geopolymers have been considered for encapsulation of radionuclide and for waste repositories. In this study, metakaolin-based geopolymer was examined for incorporation of Cs^+, Sr^{2+} and Co^{2+}. Na- and K-geopolymers and their binding ability was analyzed using zeta potential measurement and binding experiments as well as ionic-exchange in geochemical model.

2. Methodology

The prepared geopolymer was powdered for less than 150 μm and used for NMR, zeta potential, and binding experiments. The ion-exchange model is developed in a geochemical code PHREEQC. The solution of $CsNO_3$, $Sr(NO_3)_2$ and $Co(NO_3)_2$ were used in the experiments.

3. Results and discussion

The zeta potential of the geopolymer is negative and independent of Cs^+ concentration, indicating the negligible surface adsorption of CS^+. The binding experimental results show that an equal amount of Na or K is released as the uptake of Cs (Fig. 1(A)), which suggests the ion exchange between Na/K and Cs. Based on the leached amount of alkalis, the equilibrium constant for the ionic exchange was derived and used to predict the Cs binding in the geopolymer. The model prediction agrees satisfactory with experimental data (Fig. 1(B)). Similar experiments were adopted for Sr^{2+} and Co^{2+} to understand adsorption behavior and propose the immobilization mechanism in geopolymer.

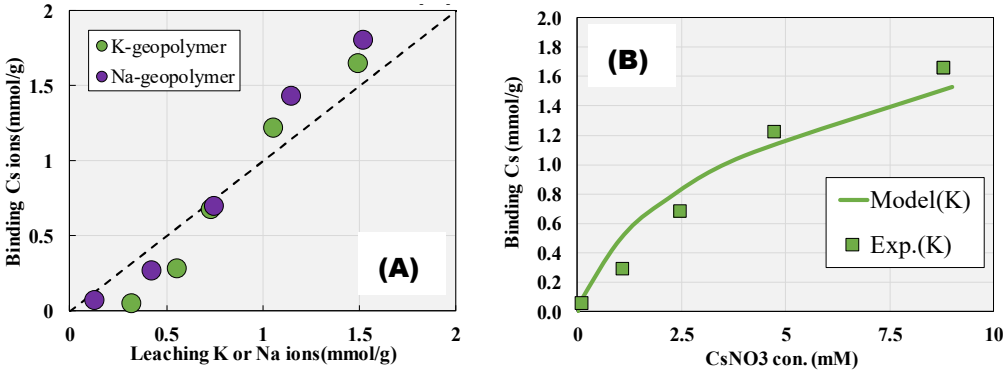

Fig. 1 (A) Relationship between bound Cs and leached K or N; (B) Predicted Cs isotherm compared with experimental data for potassium geopolymer.