

Recovery of Cs from Contaminated Soil by Subcritical Water Containing Metal Ions and Its Solidification using Inorganic Materials for Volume Reduction

(3) Mechanism of Enhanced Cs Desorption from Clay Minerals under Hydrothermal Condition

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Abstract:

Since the widespread Cs pollution following nuclear disasters, decontamination of post-accident soil has earned much attention due to the difficulty of Cs removal for its super-retention in micaceous minerals. Herein, multivalent cations (M^{2+}/M^{3+}) was successfully used in present study to desorb Cs from its saturated vermiculized biotite (VB) to clarify the mechanism of Cs removal process on microscale. Results revealed that sorbed Cs was uniformly fixed in the collapsed interlayers of VB crystals and thus was poorly and slowly desorbed by ambient treatment with cationic solutions regardless of treating concentration, duration time and number of cycles. However, almost all Cs was effectively and efficiently removed by hydrothermal treatment at 250 °C. Further characterizations of treated Cs-VB confirmed M^{2+}/M^{3+} indeed diffused into collapsed interlayers from near-edge to interior central region with increase of treating temperature and substituted anhydrous Cs^+ through a mechanism of interlayer de-collapse.

Keywords: Cesium desorption, hydrothermal treatment, volume reduction, ion exchange, decontamination

After the Fukushima accident, radioactive Cs was widely dispersed and contaminated the north-eastern district of Japan, thus the topsoil has been stripped within the top 5 cm which is now just being stored in temporary storage sites because of its difficulty of decontamination. So it is urgently essential to develop more environmental friendly and efficient techniques performing desorption of Cs^+ ions from the clay soils.

The hydrothermal treatment (HTT) process is a newly testing method to desorb Cs from the clays/soils using the subcritical water (SCW) at high temperature. This process is much attractive because of its safety, accessibility, no any secondary waste and low cost. In our study, we clarified the effect of cation species and temperature dependence on the Cs desorption from a 2:1 clay mineral, elucidated the desorption process and discussed the mechanism.

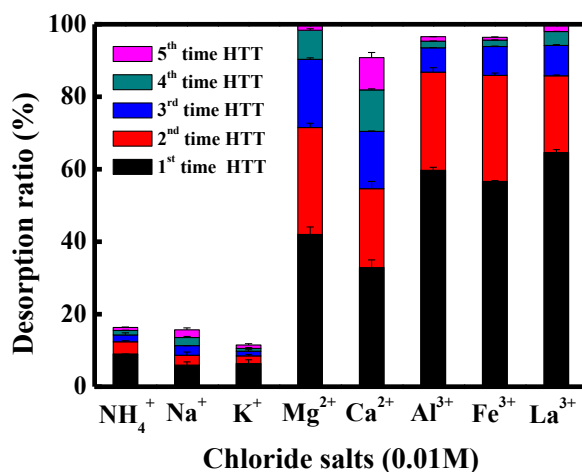


Fig. 1 HTT effect of various cations on Cs desorption from VB (V/m:50ml/0.5g; T: 250 °C; t: 30 min, Salt: 0.01M).