Effective and Efficient Desorption of Cs from Hydrothermal-treated Clay Minerals for the Decontamination and Volume Reduction of Fukushima Radioactive Soil

*Xiangbiao Yin [1], Takashi Ashida[2], Yoshikazu Koma [2],Yusuke Inaba[1], Kenji Takeshita [1]

[1] Tokyo Institute of Technology, 2-12-1, Ookayama, Meguro-ku, Tokyo 152-8550.

[2] Japan Atomic Energy Agency, 790-1 Motooka aza Ohtsuka, Tomioka-machi, Fukushima-ken, 979-1151

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 both its saturated vermiculized biotite to clarify the mechanism of Cs removal process on microscale and soil for the demonstration of Cs removal from actual radioactive materials. Results revealed that sorbed Cs was tightly fixed in the collapsed interlayers of VB crystals/soils and thus was poorly 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 from both clay minerals and actual soils 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.

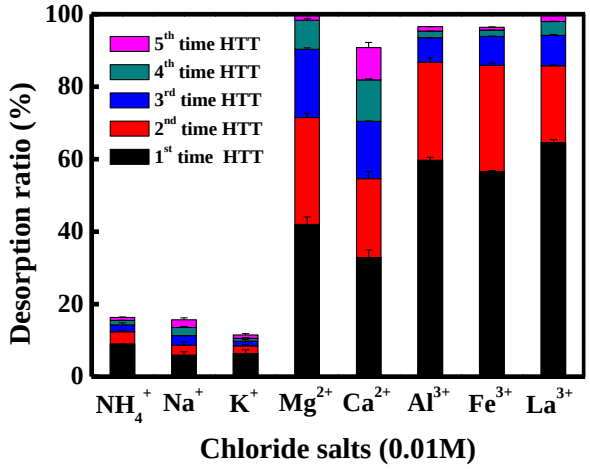

Fig. 1 HTT effect of cations on Cs desorption from VB (V/m:50ml/0.5g; T: 250 °C; t: 30 min, Salt: 0.01M)

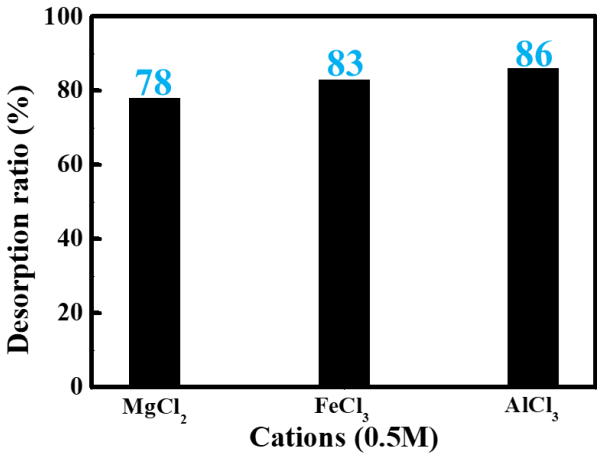

Fig. 2 HTT effect of cations on Cs desorption from soils (V/m:100ml/1g; T: 250 °C; t: 30 min, Salt: 0.5M)