Removal of Radioactive Cesium from Fukushima Contaminated Soil by Hot-pressing Water Extraction in a Column

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

[1] Collaborative Laboratories for Advanced Decommissioning Science, Japan Atomic Energy Agency

[2] Laboratory for Advanced Nuclear Energy, Tokyo Institute of Technology

Abstract: The decontamination and volume reduction of Cs contaminated soil remains a great challenge after the Fukushima Daiichi Nuclear Power Station accident. In present study, the authors aim to develop the continuous hydrothermal treatment process to remove radioactive Cs rapidly from the clay soils by a column system.

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

1. Introduction

After the Fukushima accident, radioactive Cs was widely dispersed and contaminated the topsoil, which has been stripped within the top 5 cm and being stored in temporarily because of its difficulty in decontamination.[1-2] Therefore, it is urgently desired to develop environmental friendly and efficient techniques performing desorption of Cs^+ ions from the clay soils.

2. Experiment

Radioactive Cs contaminated soil was sampled in Tomioka town (approx. 10 km to the Fukushima Daiichi Nuclear Power Station) and was preliminarily sieved to remove plant roots, litter, and gravel of >2 mm. The fine particle fraction (< 150 μ m, 15000 Bq/kg) was further sieved and dried. Subsequently, 0.5g of as-prepared soil was loaded into a stainless steel column reactor and leached with the 0.1M various solutions (KCl, NaCl, $MgCl_2$, $CaCl_2$, $AlCl_3$, $LaCl_3$, $Ce(NO_3)_3$) in flow rate of 0.25 mL/min at 150°C. The Cs concentration in the effluent was sampled at regular interval. Figure 1 shows the diagram of the column system with continuous hydrothermal treatment.

2. Result and discussion

Figure 2 shows the residual radioactivity of the treated soil and the corresponding calculated Cs desorption ratio after leaching with 50mL of each solutions at 150°C. It reveals that the radioactive Cs can barely be extracted with monovalent cations (K^+, Na^+), resulted in a desorption ratio lower than 5%. By contrast, the Cs desorption ratio is improved significantly for multivalent cations, achieving ~40% and ~60% for divalent and trivalent cations, respectively. These results suggested the column-based continuous extraction of soils with hot-compressed multivalent cations could achieve effective and efficient Cs desorption, which was expected to establish more practical technologies for treatment of the Cs-contaminated soils.

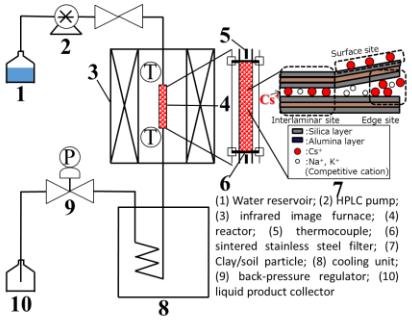

Fig. 1 Schematic diagram of continuous column system.

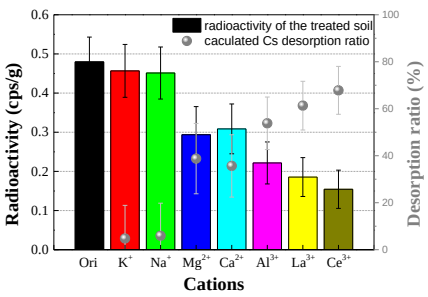

Fig. 2 Cs desorption from actual contaminated soil.

References

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