

Effect of extraction variables on the chelant-induced washing treatment of cesium-contaminated soils

ISMAIL M. M. RAHMAN^{1*}, HIKARU SAWAI²,
CHAO LU¹, ZINNAT A. BEGUM³, HIROSHI
HASEGAWA^{2*}

¹Fukushima Univ., Fukushima 960-1296, Japan
(*immrahman@ipc.fukushima-u.ac.jp)

²Kanazawa Univ., Kakuma, Kanazawa, 920-1192,
Japan (*hhiroshi@se.kanazawa-u.ac.jp)

³Southern University, Chittagong 4000, Bangladesh
(*zinnat.ara@gmail.com)

The radioactive cesium that has been released during the Fukushima Daiichi Nuclear Power Plant accident deposited in soil with rainfall, and moved to the least-mobile soil-phase. The chemical interaction between soil and cesium (Cs) has thus become stronger with time, and water-only washing technique proved less-efficient in releasing Cs from the soil. We have evaluated a technique for the decontamination of Cs-contaminated soils using aminopolycarboxylate chelant (APC) and other chemicals as additive to the washing solution.

We have used both artificial-contaminated soil and real-contaminated soils from the Namie-machi, Fukushima. The artificial samples were prepared with ¹³³Cs using the Red clay, Leaf mold and Andosol soil-types, which represents the typical Japan-origin soils available at play-yards, forests and farmlands, to study the effect of extraction variables. The APCs (e.g. EDTA, NTA, IDA, DTPA, HIDS, EDDS, MGDA, GLDA) and NH₄Cl were used among the additives. The water-mixtures with chemical-additives (50 mM each) were applied to the Cs-contaminated soils at a ratio of 10:1. The concentration of ¹³³Cs or ¹³⁷Cs in washing solutions was determined using the graphite furnace atomic absorption spectrometer or the gamma-ray spectrometer.

The washing treatment of Cs-contaminated soils with APC-spiked solution induced the release of clay-mineral-bound-Cs by dissolving the corresponding adsorption layer. The extraction variables, such as pH, APC-types, additions of multiple-extractant in mixtures, etc. were studied. The washing solution containing HIDS performed better than those with other APCs in releasing Cs from the soil-solid phase. The release rate of Cs was further enhanced when NH₄Cl was added to the solution containing HIDS, which might be attributable to the ion-exchange reaction between the ammonium ions in solution and the cesium-ions due to the similarity in ion-sizes. The washing solutions containing HIDS and NH₄Cl were used to remove 60% of the soil-bound-Cs from the contaminated Fukushima soil.