Sorption/desorption characteristics of soil layer and the effect of coexisting cations intended for in-situ containment of waste containing radioactive cesium

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1. Background and objectives

The Pacific coast of Tohoku Earthquake occurred in 2011 and the Fukushima Daiichi nuclear disaster happened. Radioactive substances were included in sewage sludge or incinerated ash around the area. In Japan the radioactive waste within 8000 Bq/kg is managed in existing MSW landfill sites. Radioactive cesium in fly ash has a high leaching rate. It is likely that this cesium leaches into this rainwater because existing MSW landfill sites in Japan allow rainwater to seep into them. Therefore wastes containing the radioactive chemicals must be separated from wastes not containing them because existing leachate treatment facilities in MSW landfill sites can't dispose of the radioactive chemicals now. Now the installation of upper layers with low permeable materials for separation and soil lower layers for Cs adsorption as a fail-safe system is suggested. Installation of soil layer such as compacted natural soil and bentonite amended soils, to function as sorption layer against radioactive chemicals, is planned for in-situ containment. Thus, cesium sorption/desorption characteristics of soil minerals under in situ conditions should be urgently assessed. In recent years a series of batch sorption and desorption tests to assess the effects of existing cations in the leachate on cesium sorption and desorption characteristics of sodium bentonite were performed. This thesis reports the results of a series of batch and column tests of sorption/desorption to assess the effects of existing cations in the leachate, such as sodium, potassium and calcium, on cesium sorption and desorption characteristics of sandy soil. Sandy soil is generated at the site and has good compaction performance and water permeability. Therefore sandy soil is assumed to be applied as sorption layer.

2. Main conclusions

(1) A series of batch sorption/desorption tests showed cations typically existing in the MSWIA leachate, such as potassium (K) and calcium (Ca), equally decreased the ability of cesium sorption by sandy soil. The ability to impede Cs sorption by sandy soil follows the order of $Ca^{2+} \fallingdotseq K^{+} > Na^{+}$ and the ability to accelerate Cs desorption from sandy soil follows the order of $Ca^{2+} > Na^{+} > K^{+}$. This result was different from the results of a series of batch sorption and desorption tests with sodium bentonite (Fig. 1).

(2) A series of column sorption tests showed potassium has the most influential effect to Cs sorption. This result is different from the batch sorption tests. A series of column desorption tests showed Cs desorption behaviors between batch and column tests are similar (Fig. 2).

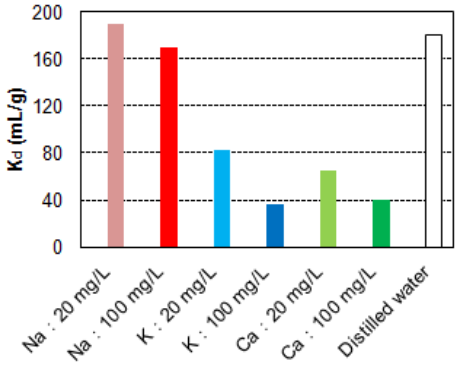

Fig. 1 The relation between cation concentration and distribution coefficient

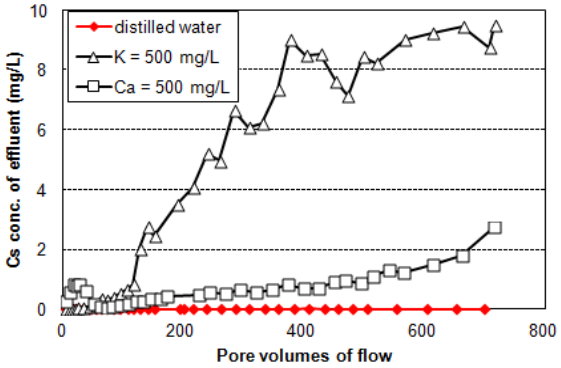

Fig. 2 The relation between Cs conc. of effluent and PVF