

Sorption/desorption characteristics of bentonite applied to in-situ containment of waste incineration ash containing radioactive cesium

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1. Background and objectives

Fukushima Daiichi Nuclear Power Plant was seriously damaged by a huge earthquake in 2011, occurred in off the Pacific coast of Tohoku region. Because of explosions occurred, large amounts of radioactive chemicals such as ^{134}Cs and ^{137}Cs were released and deposited on the land surface in the surrounding area. Radioactive cesium was adhered to soil, plants and etc. Accordingly, solid wastes generated in the contaminated area contain radioactive cesium.

Such solid wastes with concentrations of radioactive Cs lower than 8,000 Bq/kg are allowed to be disposed of at existing MSW (municipal solid waste) landfill sites. 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. This thesis reports the results of a series of batch sorption and desorption tests to assess the effects of existing cations in the leachate, such as sodium, potassium and calcium, on cesium sorption and desorption characteristics of sodium bentonite

2. Main conclusions

- (1) The results of batch sorption for cesium dissolved in the simulated leachate generated from municipal solid waste incinerator ash (MSWIA) layer indicated that the distribution coefficient (K_d) value was decreased to 8×10^1 mL/g, which was more than 2 order of magnitude lower than the K_d value of 1.0×10^4 mL/g obtained in the pure water.
- (2) Cations typically existing in the MSWIA leachate, such as sodium (Na), potassium (K) and calcium (Ca), drastically decreased the K_d values. For example, under the 500 mg/L of Na, K or Ca, K_d values of 1.1×10^3 , 7×10^2 , and 4×10^2 mL/g were obtained respectively. The lower K_d values were obtained the more concentrations of these cations increase.
- (3) The order of the adverse effect of these cations, on cesium sorption of sodium bentonite is proved to be $\text{Ca}^{2+} > \text{K}^+ > \text{Na}^+$. This order is consistent with the order of the cation exchangeability to the sorption site of the bentonite.
- (4) The results of batch desorption tests under the concentration of 500 mg/L of Na, K and Ca indicated that 18%, 32%, and 45% of cesium were desorbed respectively. The ability to desorb the cesium from bentonite follows the order of $\text{Ca}^{2+} > \text{K}^+ > \text{Na}^+$, which is consistent with the order shown in (3).

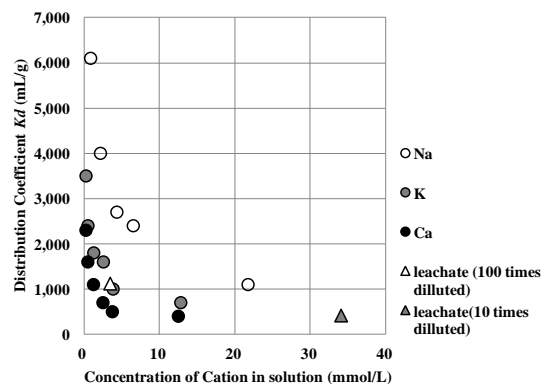
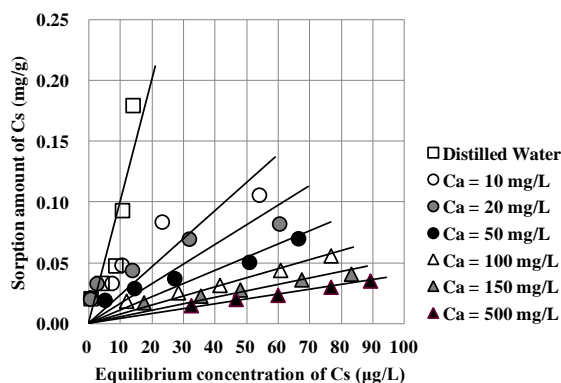


Fig.1. Sorption isotherms for Cs under various concentrations of Ca^{2+}

Fig. 2. K_d values affected by concentrations of various cations