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Original

Plant Demonstration Test on the Thermal Separation of Cesium by Melting Technique from Soil

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Summary

By the accident of Fukushima Daiichi nuclear power plant in March 2011, the east of Japan was widely contaminated by radioactive cesium (Cs). Since the accident, a variety of volume reduction technology for radioactively contaminated waste has been developed. Melting technique is considered to be one of useful high-temperature treatments carried at 1300-1400ºC. Using the technique, Cs can be separated in high efficiency from different solids degreasing their volume significantly. In our previous laboratory test, a high Cs volatilization ratio had been obtained for various solid wastes employed. Therefore, in this study, we conducted a demonstration test using a melting test plant (3 t/day) and investigated the Cs separation performance for soil, biomass incineration ash, and sewage sludge incineration ash. As a result, regardless of the kind of solid sample, Cs volatilization ratio increased by the addition of $CaCl_2$. Hence, $CaCl_2$ was considered to have a promoting effect on the Cs volatilization even in the plant scale test. The Cs volatilization ratio in the presence of combustible vegetation was higher than that without the combustibles. This shows the coexistence-effect of combustibles on the Cs volatilization. Increasing the amount of additive reagent and vegetation achieved 99.9% of the Cs volatilization ratio. Furthermore, using the two series of Bag Filer (BF) units, Cs was concentrated into the first (No.1) BF ash, and the amount of the Cs-concentrated ash was reduced by 1/3 to 1/4 compared with the case of using one BF equipment. The No.1 BF ash was primarily composed of alkali metal chloride, and Cs in the No.1 BF ash was highly water-soluble. This indicates that the secondary treatment of Cs by wet process (water elution - solid-liquid separation - Cs adsorption) is possible. The second (No.2) BF ash was composed of neutralized products of acid components (HCl and SO_x) in flue gas as follows; CaClOH, $CaCl_2 \cdot 4H_2O$, $CaCO_3$ and $Ca(OH)_2$. Therefore, the No.2 BF ash is considered to be reusable as the melting addition reagent.

Key Words: Cesium, Soil, Melting, Thermal separation, Chlorination volatilization