Distribution of Radioactive Cesium in Soil and Practical Approach to Decontamination in Fukushima

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Radiation measurements of radiocesium released from the Fukushima NPP revealed that radiocesium in the environment was present at higher levels in solid phases, especially the surface of soil and other terrestrial surfaces. The decontamination operation has removed some of the contamination which is being transferred to temporary storage facilities intended to be used for three years. According to the roadmap of decontamination designed by Japanese government, the decontamination waste, such as removed contaminated soil is intended to be stored in interim storage facilities for 30 years, within several years. Meanwhile, the waste generation and temporary storage, amounting to approximately 16 to 22 million m^3, is incurring with significant labor and other costs. The volume could exceed the capacity for interim and long term disposal. Therefore, practical methods for volume reductions are being developed in Fukushima.

A wet classification method that comes from a countermeasure for soil contamination based on a mineral processing technology is being developed as a potential volume reduction method. The method was examined using 2 types of soil samples collected at Tsushima (Namie) and Okuma located close to Fukushima nuclear power plant, to verify the practicability and availability of the classification process. After wet classification with sieves and radiation measurements, the radiocesium activity concentration of the fraction of classified large particles which were more than 125 *μm* in the Tsushima samples was low as compared with the fine particle fraction. On the other hand, the radiocesium activity concentration of the fraction of large particles more than 125 *μm* was similar to the fine particles size in the range of 20 to 125 *μm*. Conversely, the particle size less than 20 *μm* includes noticeably higher amounts of radiocesium than larger particulate fraction of the Okuma sample. This result was not only different from the Tsushima sample, but also suggested that the the wet classification was ineffective as a volume reduction method.

Two large particle fractions size 500 *μm* to 2 *mm* and 2 to 4.45 *mm* in 2 soil samples were observed further to improve understanding of the distribution of radiocesium with particle size. Specifically, the large particles in the fractions were sorted by color and appearance by hand, and each sorted group was measured for radiocesium. The first group with colors of white, gray and orange mainly consisted of Quarts, and had the lowest radiocesium activity concentration. However, that of groups such as the soil aggregate and the organic matter were relatively high. Moreover, particles in only Okuma sample which were clay minerals that appeared to be weathered biotite or vermiculite, had the highest radiocesium activity concentration. This results followed the accepted theory that clay minerals are major adsorbent of cesium in a natural soil.

The most common size of clay minerals on the particle classification was less than 2 *μm* in the fine particulate fraction. As for Tsushima sample, the wet classification method has a beneficial effect on volume reduction because of the removal of fine particles including clay minerals accumulating cesium. The soil aggregate and the organic matter containing radiocesium that stay in large particle fraction can be processed by incineration or attrition using practical classification processing. However, the large clay minerals in the Okuma sample indicated the requirement for improving the conventional classification method.