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Detailed analysis of isotopic ratio of radioactive iodine in surface soil around Fukushima Daiichi Nuclear Power Plant

Yasuto Miyake (1), Hiroyuki Matsuzaki (1), Takeshi Fujiwara (2), Takumi Saito (2), Takeyasu Yamagata (3), and Maki Honda (4)

(1) Department of Nuclear Engineering and Management, School of engineering, The University of Tokyo, Japan (taizanhokuto62@gmail.com), (2) Nuclear Professional School, School of Engineering, The University of Tokyo, Japan, (3) College of Humanities and Sciences, Nihon University, Japan, (4) Graduate School of Integrated Basic Sciences, Nihon University, Japan

In March 2011, there was an accident at the Fukushima Daiichi Nuclear Power Plant (FDNPP) and a lot of radionuclides were discharged into the environment, resulting from a powerful earthquake and tsunami. Considering the impact on human health, the radiation dosimetry is the most important for Iodine-131 among radionuclides in the initial stage immediately following the release of radionuclides. However, Iodine-131 cannot be detected after several months owing to its short half-life (8 days). Cesium-137 was also leaked out from the FDNPP and this can be detected now. But this did not identically act with Iodine-131 and be suitable for the reconstruction of Iodine-131 distribution at the initial stage. Since Iodine-129 (half-life: 1.57E7 yrs) can be detected in the future and it act chemically identically with Iodine-131, the reconstruction by Iodine-129 analysis is important. For this reconstruction, it is necessary to know the isotopic ratio of radioactive iodine (129I/131I) released from the FDNPP.

In this study, the Iodine-129 concentration was measured by accelerator mass spectrometry (AMS) in several surface soil samples collected around the FDNPP for which the Iodine-131level had already been determined.

Soil samples were put into a U8 standard vessel after being roughly homogenized and dried. Then, samples were homogenized again more completely and several grams were taken for Iodine-129 measurement. Each sample was combusted in a quartz tube and outgas was trapped in alkali solution. An aliquot was taken from the trap solution for the determination of the Iodine-127 concentration by inductively coupled plasma mass spectrometry (ICP-MS). The iodine carrier was added to the trap solution, from which the iodine fraction was purified by solvent extraction and back extraction. Finally, silver iodide precipitation was obtained by adding silver nitrate solution. After dried, the precipitation was mixed with niobium powder and pressed into a cathode for the target at the ion source for AMS. 129I-AMS was performed at MALT (Micro Analysis Laboratory, Tandem Accelerator), The University of Tokyo.

The Iodine-127 concentration ranged from 0.21 to 17.4 ppm and the surface deposition amount of Iodine-129 was between 11.8 and 6.06E3 mBq/m2 within the 60 km distant from the NPP. Iodine-129 and Iodine-131 data had good linear correlation.

However, the distribution of isotopic ratio of soil samples is somewhat asymmetric and this might suggest that this distribution is affected by different distributions, indicating more than two sources.