Aging Effect on Speciation and Soil-to-Plant Transfer of Cs and I in Soil

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Abstract

Aging effect of radionuclides in soil after deposition is an important factor for their speciation and soil-to-plant transfer. Laboratory experiments for the aging effect of Cs and I using stable nuclides were carried out for periods of 7 - 20 months and 0 - 7 months, respectively. The stable Cs or I were added to a soil sample, which was collected from a grassland area in Rokkasho where the first commercial spent nuclear fuel reprocessing plant in Japan is located. Iodine was added to the soil as I^- or IO_3^- to examine the effect of chemical form on the behavior in soil. The soil sample was put into cultivation pots, and the soil-filled pots were stored in an artificial climate chamber. Orchardgrass or red clover plants were cultivated in the pots for 28 d several times during the experiments, and the soil-to-plant transfer factors of Cs and I were determined. Extractability of Cs and I in the soil sample was occasionally determined by pure water or 1 M ammonium acetate solution for Cs, and only pure water for I. Decreasing patterns of their extractabilities were compared with the transfer factors.

We have already reported that the soil-to-plant transfer factor and the extraction yield of Cs in the soil decreased with time up to 7 months after its addition. Their further decreases were not observed from 7 to 20 months after the addition. Both the soil-to-plant transfer factor and the extraction yield of I decreased with time during 7 months after its addition as I^- or IO_3^-. The transfer factors of IO_3^- were higher than those of I^- up to 86 d after the addition, however, those at 177 d after the addition were similar to each other. Higher extractability of IO_3^- than I^- was also observed during a similar period after the addition. The decreasing pattern of the extraction yield of Cs with pure water agreed with that of its transfer factor. Although the extraction yield of I with pure water showed a fairly similar pattern to that of its transfer factor, its similarity was less than that shown by Cs.

When the soil-to-grass transfer factors of Cs and I in the present study were compared to those which were used for the safety review of the spent nuclear fuel reprocessing plant in Rokkasho, the latter were found to overestimate the transfer beginning at 4 months after their addition to the soil.

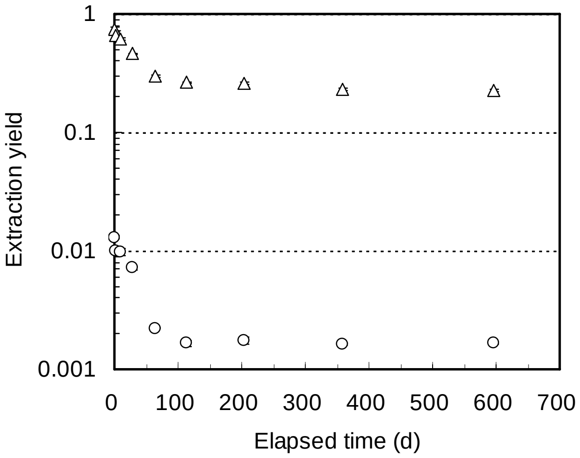

Fig. 1 Extraction yield of Cs added to the soil. ○, water extraction; Δ, ammonium acetate extraction. A standard deviation (n=3) is within the range of each symbol.

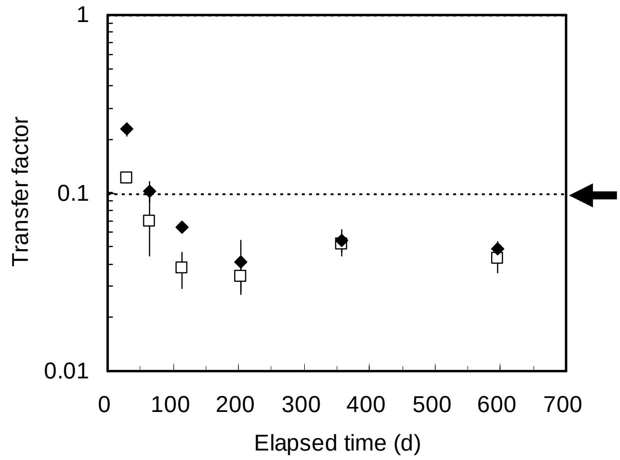

Fig. 2 Soil-to-plant transfer factor of Cs determined by pot experiments. ◆, Orchardgrass; □, Red clover. Error bars indicate a standard deviation (n=3). The arrow indicates the soil-to-grass transfer factor of Cs which was adopted for the safety review of the spent nuclear fuel reprocessing plant in Rokkasho. Data are shown as dry weight basis,

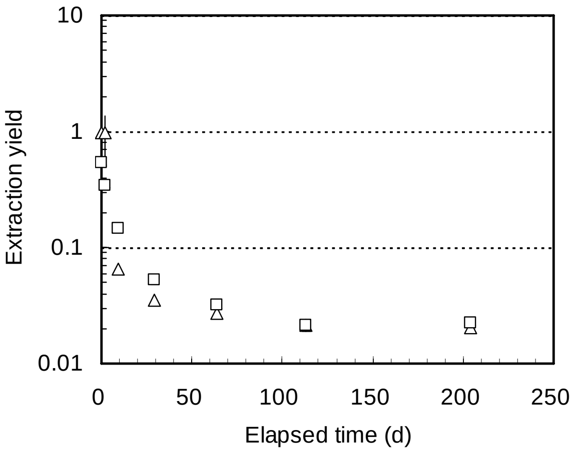

Fig. 3 Extraction yield of I added to the soil by water extraction. Δ, I added to soil as I^-; □, I added to soil as IO_3^-. Error bars indicate 1 standard deviation (n=3).

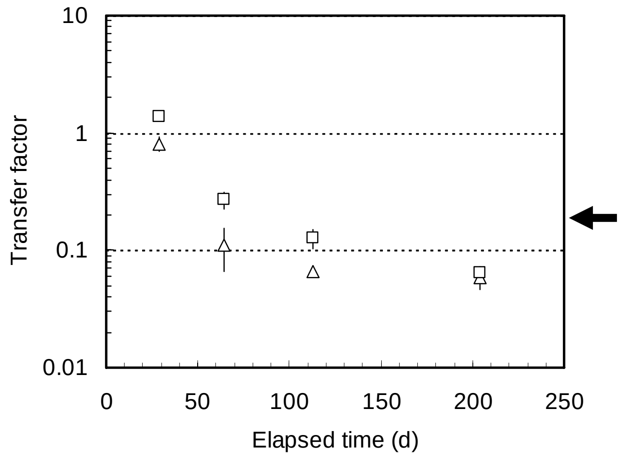

Fig. 4 Soil-to-plant transfer factor of I determined by pot experiments (Orchardgrass). Δ, I added to soil as I^-; □, I added to soil as IO_3^-. Error bars indicate 1 standard deviation (n=3). The arrow indicates the soil-to-grass transfer factor of I which was adopted for the safety review of the spent nuclear fuel reprocessing plant. Data are shown as dry weight basis, assuming 10% water content in grass.