1–9 Study of the Contamination State inside the Reactor Building

— Detailed Radiochemical Analysis to Accelerate Disposal of Waste —

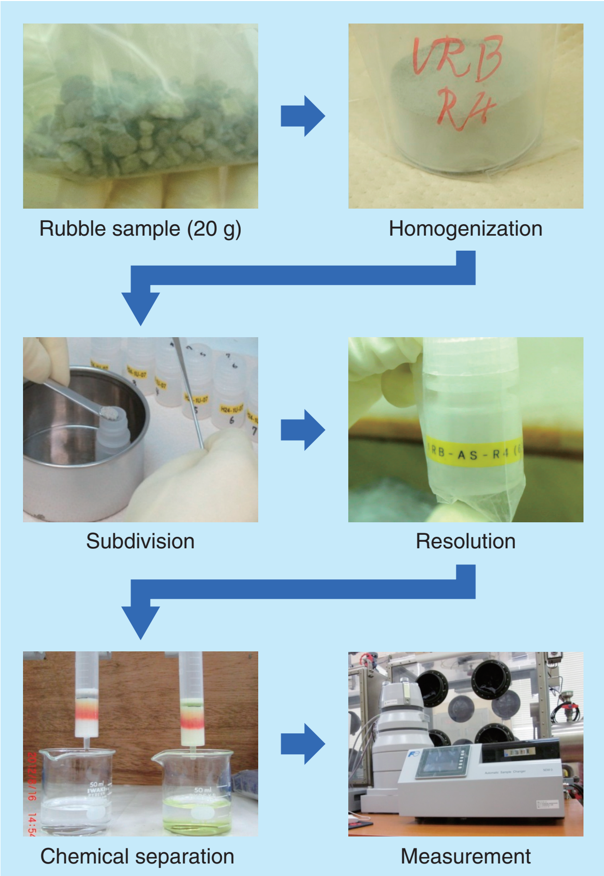

Fig.1-19 Flow of radiochemical-analysis operation
Rubble samples are pulverized using a ball mill for homogenization. The homogenized samples are subdivided and a pretreatment / separation method is carried out suitable for each nuclide.

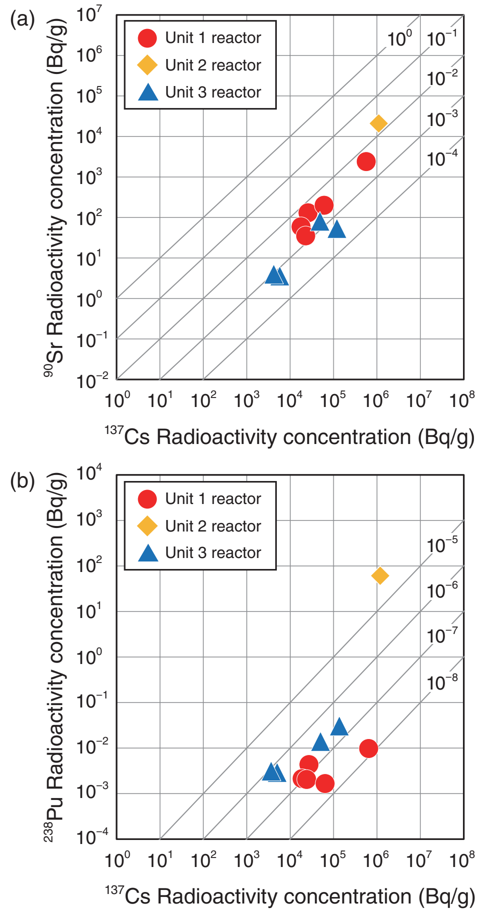

Fig.1-20 Measured radioactivity-concentration results
Concentrations of (a) ^{90}Sr and (b) ^{238}Pu as functions of that of ^{137}Cs (Corrected on March 11, 2011).

For the decommissioning of the TEPCO's Fukushima Daiichi NPS (1F), the establishment of disposal policies for the waste (including rubble) that will be generated is an urgent task. To accelerate waste treatment and subsequent disposal, it is first important to clarify information such as the radionuclide and radioactivity concentrations of waste generated by the accident. Therefore, we conducted radiochemical analysis of rubble collected in the reactor buildings (Fig.1-19).

Fig.1-20 shows an example of the nuclides detected among the acquired data for radioactivity concentration. The ^{90}Sr concentration tended to be proportional to that of ^{137}Cs with a correlation coefficient of 0.89. Thus, there is a possibility of estimating ^{90}Sr concentration, which is difficult to directly measure, based on radioactivity from ^{137}Cs (which is easy to measure). On the contrary, it was not clear that the ^{238}Pu concentration was proportional to the ^{137}Cs concentration with a correlation coefficient of 0.51, and further accumulation of radioactivity-concentration data is necessary.

The ^{90}Sr/^{137}Cs ratio of Units 1, 2, and 3 obtained by radiochemical analysis were $(3.2 \pm 1.5) \times 10^{-3}$, 1.9×10^{-2}, and $(8.1 \pm 4.6) \times 10^{-4}$, respectively. These values were 1 to 3 orders of magnitude smaller than the ^{90}Sr/^{137}Cs ratio in fuel in the nuclear reactor calculated by computer code (ORIGEN2). The analytically obtained ^{238}Pu/^{137}Cs ratios of Units 1, 2, and 3 were $(6.0 \pm 6.4) \times 10^{-8}$, 5.5×10^{-5}, and $(3.9 \pm 1.9) \times 10^{-7}$, respectively. These values were 3 to 6 orders of magnitude smaller than the ^{238}Pu/^{137}Cs ratio calculated by the computer code. Therefore, the extent of transport from fuel to the reactor building is suggested to occur in the order ^{238}Pu < ^{90}Sr < ^{137}Cs.

Results obtained by radiochemical analysis are expected to be used not only for estimating the amount of radioactivity inside the reactor building, but also to evaluate the radiation exposure to workers and the environment. We will continue to analyze radioactive waste from 1F and accumulate radioactivity-concentration data for treatment and subsequent disposal.

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Reference

Sato, Y. et al., Radiochemical Analysis of Rubble Collected from Fukushima Daiichi Nuclear Power Station, Hoken Butsuri, vol.51, no.4, 2016, p.209-217 (in Japanese).