

Mitigation of radionuclide deposition in contaminated water: Effects of Fe³⁺ hydrolysis on the precipitation of Cs⁺ and Sr²⁺

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Fission products such as caesium-137 and strontium-90 can cause additional expenses for transporting the radioactive waste water through pipes, especially when they form pipe scales and overheat their surroundings. Iron(III) ions in the water readily undergo hydrolysis to form (hydr)oxide. The fission products dissolved in the water may coprecipitate with the iron(III) (hydr)oxide, increasing the radioactivity of the precipitates. Prior to the main experiment, observations were made on the solid substances formed in aqueous solutions of either 20 mmol dm⁻³ caesium chloride or 20 mmol dm⁻³ strontium chloride, in the initial pH range of 6 (or 7) to 13; the pH of the solutions was adjusted by adding aqueous sodium hydroxide. No observable solid substances were present in the caesium chloride solution with a pH ≤ 13, whereas in the strontium chloride solution with a pH ≥ 9, more solids were found as the pH increases. The main experiment was conducted with aqueous solutions of iron(III) chloride, and either caesium chloride or strontium chloride, to quantify the amounts of caesium (Cs) and strontium (Sr) in the precipitates; the pH of the solutions was adjusted to be within the range of 7 to 13. Inductively coupled plasma spectrometry indicated that Sr²⁺ precipitates more than Cs⁺ together with iron(III) (hydr)oxide, and that the mass fraction of Sr present in the precipitates is linearly proportional to the initial pH. The data obtained may be used to estimate the radioactivities of pipe scales or those of radioactive waste water.

ACKNOWLEDGMENTS

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIP: the Ministry of Science, ICT and Future Planning) (No. 2017M2A8A4015281).