

Metakaolin-based Geopolymer for Immobilizing Concentrated Cs Generated by Volume Reduction of ^{137}Cs -contaminated Waste

ICHIKAWA Tsuneki^{1, 2*}, WATANABE Sadayuki³, ARAI Hiroyuki², HAGA Kazuko⁴, and YAMADA Kazuo²

● **Summary** ● Cs-loaded geopolymer, cation exchangeable amorphous aluminosilicate prepared by mixing metakaolin, water glass and water-soluble CsCl at ambient temperature, was found to immobilize Cs strongly and to release it very slowly into sea water. The leaching test of geopolymer containing 9.1% by mass of Cs showed that geopolymer prepared from 10 : 15 weight ratio of metakaolin and water glass held more than 97% of Cs after prolonged immersion in deionized water. The leaching restarted in seawater, though the effective diffusion coefficient for Cs leaching was as low as $1.96 \times 10^{-5} \text{ cm}^2/\text{h}$. The theoretical analysis of the leaching process including ionic diffusion and ion exchanging revealed that the slow release was due to the high selectivity coefficient of cation exchange sites for Cs^+ adsorption and much higher concentration of adsorbed cations in the pore solution of geopolymer than that of cations penetrated from sea water. The low leaching ratio in deionized water and the slow leaching rate in seawater indicate that geopolymer is possible to be used as an immobilizer-solidifier for concentrated Cs generated by volume reduction of ^{137}Cs -contaminated waste.

Key Words: radioactive waste, decontamination, ^{137}Cs , volume reduction, geopolymer, immobilizer, metakaolin, water glass

Received October 18, 2019; Accepted December 20, 2019

*Corresponding author: E-mail: tsuneki@eng.hokudai.ac.jp

¹Hokkaido University, Home address: 8-1-27 Tonden 3, Kita-ku, Sapporo, Hokkaido 002-0853, Japan

²National Institute for Environmental Studies, Fukushima Branch, 10-2 Fukasaku, Miharu, Fukushima 963-7700, Japan

³Tokyo Metropolitan Industrial Technology Research Institute, 2-4-10, Aomi, Koto-ku, Tokyo 135-0064, Japan

⁴Taiheiyo Consultant, Co. Ltd., 2-27-8 Nihonbashi, Chuou-ku, Tokyo 103-0004, Japan