Source Identification and Simulation of Radiocesium Infiltration into Separate Sewer System after Nuclear Power Plant Accident

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Following the Fukushima Dai-ichi nuclear power plant accident, numerous amount of radiocesium was emitted and infiltrates separate sewer system in the surrounding urban areas. To simulate the infitration of radiocesium into separate sewer, we developed the Improved Model Radionuclide Migration in Urban Environments and Drainage Systems (iMUD) bases on model Radionuclide Migration in Urban Environments and Drainage Systems (MUD), which was only applicable for combined sewer system. In this study, we attempted to predict the concentration of radiocesium in the final sludge of wastewater treatment plant (WWTP).
iMUD is a multi compartment model, consits of urban and WWTP sub-model and divides the surface of urban area into five components according to the type of surface layer (roof, paved, soil, tree, wall). Firstly we identified the mechanism of radiocesium infiltration, which after several analysis, the mechanisms are Rainfall-Derived Inflow and Infiltration (RDII) and Human excretion. There after, the model was applied on the two largest urban areas in Fukushima Prefecture, Fukushima and Koriyama. Finally, we compared the predicted values of concentration of radiocesium in the sludge with the three years obeserved data in order to validate the model.
Based on the calculation of Nash Efficiency Coefficient (n), the model showed a satisfactory result, which for Fukushima WWTP case n value of 0.85, and for Koriyama WWTP case, n value of 0.84 were achieved. In addition, R^2 value of 0.85 and 0.86 were achieved for Fukushima and Koriyama respectively. We predicted that the sludge containing radiocesium reaches the standard limit after 3 years for Fukushima and 4 years for Koriyama.

Keywords: radiocesium, separate sewer system, simulation

