Research Highlights

New technique for removal of radiostrontium from wastewater and possible waste management.

Large amounts of radioactive nuclides were released into the environment when the Fukushima Daiichi Nuclear Power Plant was damaged by the earthquake on March 11, 2011 [1, 2]. Among these, the more long-lived radioactive nuclides, such as ^{134}Cs, ^{137}Cs and ^{90}Sr - which have half-lives of 2.06, 30.17 and 28.79 years respectively - are of great concern in terms of environmental contamination. ^{137}Cs, which emits γ rays, has been used to evaluate the environmental monitoring and decontamination, because it is easily detected using various instruments. However, ^{90}Sr emits only β rays, and requires a complicated extraction and purification process for analysis. Therefore, few studies on ^{90}Sr release have been performed so far.

Several methods can be used to remove metal ions from wastewater, such as chemical precipitation, ion exchange, membrane treatment, and adsorption. Adsorption is one of the most commonly used methods due to its simplicity and selectivity. For the separation of strontium ions, various types of organic and inorganic adsorbents have been reported.

Toshiro Ono and colleagues at Okayama University developed an effective system for removing ^{90}Sr from aqueous solution, which is based on the hydroxyapatite (HAP) column procedure. HAP is a major mineral constituent of bone and tooth and has an outstanding biocompatibility. HAP is also a possible sorbent for heavy metals in wastewater due to its high adsorption capacity and low water solubility.

In their tests, the researchers found that more than 90% of ^{90}Sr was adsorbed onto HAP particles. This was far more effective than tests using zeolite, which has been commonly used for ^{137}Cs adsorption (Fig. 1). The adsorption of ^{90}Sr by HAP was not influenced by calcium ion concentrations of up

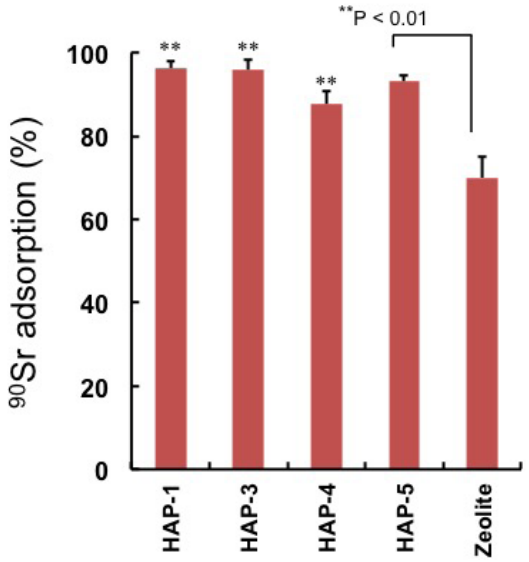

Fig. 1 Adsorption efficiency of ^{90}Sr onto HAP and zeolite examined on competing cation-free solution. *P<0.01 by unpaired Student's *t* test.

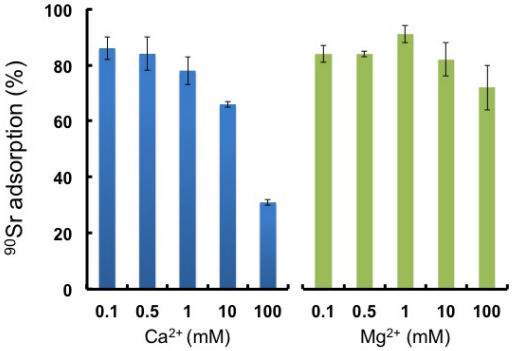

Fig. 2 Effect of competing Ca^{2+} and Mg^{2+} ions on ^{90}Sr adsorption onto HAP.

to 1 mM – more than the average concentration of calcium ions in natural water, which is 15-20 mg/ L (0.375-0.5 mM) in Japan. Furthermore, magnesium ions had little effect on the removal of ^{90}Sr over the entire concentration range that was tested (Fig. 2). Once the ^{90}Sr was adsorbed, the researchers stripped it from the column using a small amount of eluate. They were then able to use the regenerated column for a further round of separation.

The researchers are hopeful that their HAP column technique could be useful for removing ^{90}Sr from wastewater as well as natural water in the environment. The concentrated ^{90}Sr adsorbed onto HAP could then be stored securely as dry solid waste, reducing the required disposal space and lowering costs (Fig. 3).

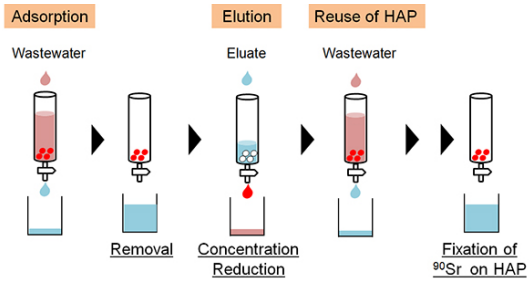

Fig. 3 Concentration and volume reduction of wastewater and fixation of ^{90}Sr on HAP particles for the storage as dry solid waste.

[1] K. Hirose, J. Environ. Radioact., 111, 13-17 (2012)
[2] K. H. Harada, T. Niisoe, M. Imanaka, et al., Proc. Natl. Acad. Sci. USA, 111, E914-E923 (2014)

Reference:

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