

Removal of spallation products in water by ion-exchange method

J. Kitagawa^{1#}, K. Bessho¹, M. Hagiwara¹, M. Numajiri¹,
T. Miura¹, K. Takahashi¹, K. Saito¹, Y. Miyamoto², K. Seki²

¹Radiation Safety Section, J-PARC center, KEK, Tokai, Ibaraki 319-1195, Japan

²Radiation Safety Section, J-PARC center, JAEA, Tokai, Ibaraki 319-1195, Japan

a corresponding author: E-mail kitajun@post.kek.jp

In the accident at the J-PARC Hadron Experimental Facility, a bunch of proton beam accelerated at the Main Ring was extracted in an anomalously short period of time due to a malfunction of the beam extraction system and hit the primary target made of gold. As a result, the target is partially evaporated and radionuclides are discharged into the experimental hall [1]. Various radionuclides are generated in heavy metal targets by spallation reactions at high-energy proton accelerator facilities. In the radiation safety issue at high-energy accelerator facilities, special care should be taken for radionuclides which have a long half-life and a tendency to transfer into water and/or air media. When radionuclides are generated in the solid targets and transfer into water thereafter, some nuclides exist in soluble ionic form; the other are associated with colloidal and particle species. Radionuclides behave complicatedly in water as a result of these various existing states [2].

Ion-exchange method is one of promising techniques to remove radionuclides contained in water media. Ionic-state nuclide species can be collected by passing through the ion-exchange resin units, on the other hand electrically-neutral nuclide species cannot be removed by ion-exchange resins. We examined the removal characteristics of typical radionuclides generated by spallation reactions at the high-energy proton accelerator facilities. Ion-exchange columns (Resin bed: 20 mm Φ x 55 mm) were prepared by filling the cylinders with a mixture of anion-exchange resin and cation-exchange resin (1:1). Water sample was prepared as an aqueous solution which contains typical nuclides detected in the Hadron Experimental Facility after the accident: ¹²⁵I, ¹⁸³Re, ¹⁸⁵Os. The water sample was passed through the ion-exchange column at the flow rate of 3 ml/ min. The fractions eluted from the column were collected until 90 ml and the activities of the eluents were measured with a high-purity Ge detector. After passing through the ion-exchange resin column, the removal rates of ¹²⁵I, ¹⁸³Re, ¹⁸⁵Os were found to be >99%, >92% and >96%, respectively.

References

- [1] High Energy Accelerator Research Organization (KEK), Accident at J-PARC Hadron Experimental Facility, 2013., <http://legacy.kek.jp/intra-e/info/2013/052714/>
- [2] H. Matsumura, N. Kinoshita, A. Toyoda, K. Masumoto, K. Bessho, M. Hagiwara, Y. Yamanoi, *Nucl. Technol.*, 168, 979-983 (2009)