

## Development of Ra in the Sea Water Collection Technology for Production of Medical Tracer Ac-225

Kaori Oguri<sup>1</sup>, Yoichi Arai<sup>1</sup>, Sou Watanabe<sup>1</sup>, Noriaki Seko<sup>2</sup>, Hiroyuki Hoshina<sup>2</sup>

<sup>1</sup>Japan Atomic Energy Agency, <sup>2</sup>National Institutes for Quantum Science and Technology

### Summary

Radium-226 (<sup>226</sup>Ra) has recently attracted attention as a source for the production of actinium-225 (<sup>225</sup>Ac), which can be used for the  $\alpha$ -particle therapy of cancer. <sup>226</sup>Ra is present in approximately 10,000 tons in the sea. The amount of <sup>226</sup>Ra in seawater could help patients with metastatic cancer around the world. Therefore, we focused on the extraction of <sup>226</sup>Ra from seawater and examined an effective process for refining <sup>226</sup>Ra. Due to the low concentration of <sup>226</sup>Ra in seawater, only a few ppb, it has not received much attention in terms of economic point. Therefore, we focused on adsorbents prepared by Radiation-Induced Graft Polymerization to selectively collect Ra. In this study, we performed adsorption studies with Barium (Ba), homologs element of Ra, which may coexist with Ra in seawater.

To develop adsorbent material for collecting Ra from seawater, we selected adsorbent groups such as diglycolamide (DGA), iminodiacetic acid (IDA), N-methyl-D-glucamine (NMDG), diethylamine (DEA), phosphoric acid (P) with high affinity to Ra and synthesized adsorbents by immobilizing each on a polyethylene nonwoven fabric substrate. As a result, a highest Ba adsorption rate was observed under pH range of 4-8 conditions for P-type adsorbent. It was shown the highest adsorption rate of 21.8 mg/g at pH 6. IDA-type adsorbent was more than that rate of 6 mg/g. On the other hand, DGA, NMDG and DEA-type adsorbents were less than that rate of 1mg/g under pH 4-8.

The elution rate of Ba eluted from adsorbents (IDA, P-type) after 18 hours of immersion in each elution solution such as HNO<sub>3</sub>, citric acid and malic acid. P-type adsorbent had a larger elution rate than IDA adsorbent. Especially, HNO<sub>3</sub> had the highest elution rate. In addition, P-type adsorbent was able to elute all Ba.

It is expected to be contaminated in Alkali metals and alkaline earth metals such as Na, K, Ca, Sr and Al in seawater. Therefore, to develop the separation process for these elements, especially Sr, we selected an optimal extraction for separation of Ra. In the extraction using simulated seawater, the DGA extractant has a large  $K_d$  and a large Ba recovery rate of about 90%. On the other hand, separation performance was excellent for crown ether extractant. It only Ba was recovered.

To establish <sup>226</sup>Ra recovery technology, we will continue to research Ra purification methods using <sup>228</sup>Ra tracer and <sup>226</sup>Ra in seawater and natural water. In the future, we will contribute to domestication and global clinical popularization for <sup>225</sup>Ac.