Development of radioxenon abatement system for fission Mo-99 production process

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1. Introduction

Molybdenum-99(Mo-99), the mother nuclide of technetium-99m(Tc-99m), is the most essential medical radioisotopes. Tc-99m is extracted from decaying Mo-99 in the Mo-99/Tc-99m generator when it is actually needed in hospitals, and widely used for various diseases diagnosis. Mo-99 can be produced by the (n, γ) method using research reactors or accelerators, but it is more preferred to separate from the fission products of uranium due to its relatively high specific activity.

In the management of radiowastes from fission Mo-99 production processes, abatement of the radioxenon emission is a major issue due to its interference with the nuclear test monitoring activities. To meet the CTBTO suggestion (maintained under 5 GBq/day), KAERI developed the high performance abatement trap, and designed a proto-type equipment for the FMPP in new research reactor.

2. Methods and Results

To abate the emission of radioxenon from FMPF, the combination of delay tanks and beds for decaying radioxenon has been widely used as a conventional system. However it requires huge sites and budget to build and install the decay tanks. In this research, we developed compact charcoal delay bed system which can substitute the enormous radioxenon delay tanks.

Activated charcoal has been widely used as the adsorbent for the radioxenon delay bed, but it has a poor adsorption efficiency due to its properties of inert gas. As previously reported, adsorption efficiency of the activated charcoal can be dramatically increased by decreasing the bed operating temperature.

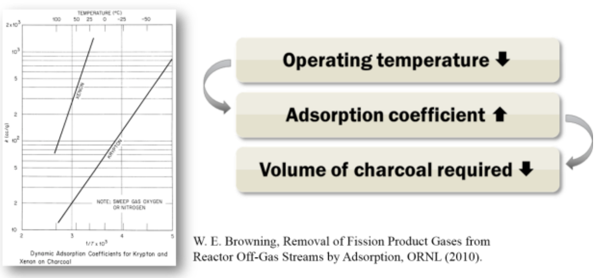

Fig. 1. Relationship between the adsorption coefficient of activated carbon and operating temperature of delay bed.

We designed the charcoal delay bed which can be operated with low temperature. Lab-scale equipment was tested under various operating temperature, and the results showed that there was a significant increase in adsorption efficiency (more than 5-times higher) between 20℃ and -20℃ condition.

Furthermore, with a collaboration with PNNL(Pacific Northwest National Laboratory, USA), a multiphysics adsorption model was developed to validate the bed design and determine the operating parameters.

3. Conclusions

To mitigate a radioxenon emission, a compact delay bed system was fabricated and evaluated. Even though the scale-down bed design, an improved adsorption performance could be obtained by lowering bed temperature. Further studies for the design optimization are being planned, and the results will be reflected to the detailed design of Mo-99 production facility for complete substitution of the huge decay tanks.

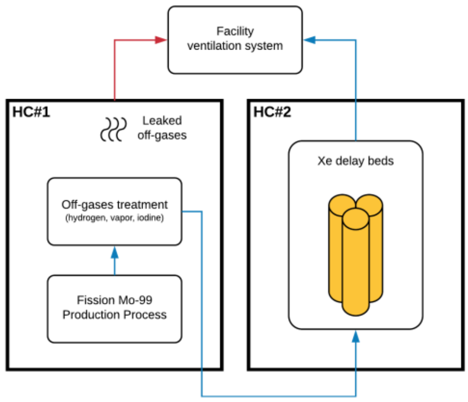

Fig. 2. Conceptual figure for utilization of the compact radioxenon delay bed in fission Mo-99 production process.

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