Sampling Procedure for a Radionuclide Assessment of a Spent HEPA Filter Waste

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1. Introduction

According to the operation of nuclear facilities and a continuous construction of them, a great amount of used high efficiency particulate air (HEPA) filters which are widely used in a ventilation system in the nuclear industry has been generated as spent filter waste. All these HEPA filter wastes generated at KAERI have been stored in accordance with the original form without any treatment of them. However, to secure space in a waste storage facility approaching saturation, it is desirable to treat them by a compaction in view of a radioactive waste treatment and storage, and finally, to repack the compacted spent filters into a 200 liter drum for sending them to a disposal site [1,2].

In order to dispose of the HEPA filters, it is first necessary to conduct a radionuclide assessment of them before compacting them. However, it is difficult to directly measure a radioactive concentration level of the nuclides captured in a HEPA filter because of its great bulk and specific shape. Therefore, after taking a representative sample from a HEPA filter, the analysis results for it are regarded as a representative value for the corresponding HEPA filter. To use this method, it is essential to confirm the validity of the sampling procedure and representative value.

In this study, the depth distribution of the captured nuclides in a HEPA filter waste was first investigated. From the results, it was possible to obtain a representative sample from the intake part and the outlet part of a HEPA filter without a dismantlement. And then, a punch device with a diameter of 2 inch was developed for taking a representative sample which has a regular size.

Methods and Results

The shape of a HEPA filter is a rectangular parallelepiped form filled extensively with a pleated filter medium made from a mixture of glass fibers in the metal filter case and its whole size is 60.96 ㎝ (H) × 60.96 ㎝ (W) × 30.48 ㎝ (D) [3].

2.1 Depth distribution of the captured nuclides

After selecting several spent HEPA filters from the main generation facilities, a nuclide assessment for a filter medium was conducted according to the depth of a HEPA filter. As a consequence, it was possible to obtain three kinds of representative distributions in the filter medium, as shown in figure 1. First, the concentration of the captured nuclide in the intake part of the air flow was higher than the middle or the outlet part of the filter medium (Type A). Second, contrary to the first, the concentration of the captured nuclide in the outlet part was higher than any other part (Type B). And third, a mixture of the first and the second, the concentration of the captured nuclide in the intake and the outlet part was higher than the middle part (Type C).

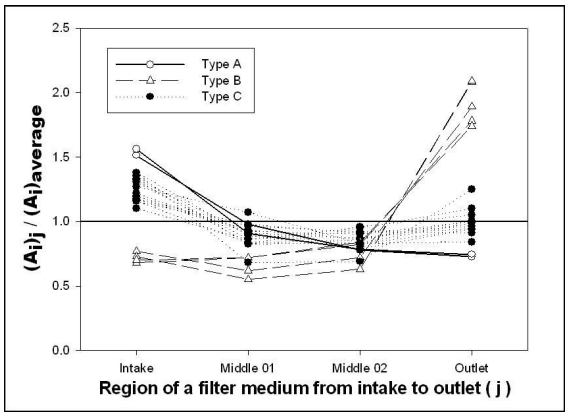

Figure 1. A representative distribution form of captured nuclides in the filter medium

In view of the geometry of a HEPA filter, the intake and the outlet part will show a high dispersion of the air flow and have a large area directly contacting the air flow, when compared with the middle part of a filter medium. Therefore, the concentration of the captured nuclides was generally higher at the intake or the outlet part because of the high probability of a collision of the particles with the glass fiber in the filter medium in those regions. The middle part generally represented a uniform distribution below the average specific activities of each nuclide.

2.2 Development of a punch device

As shown in figure 2, a punch device with a diameter of 2 inch was developed for cutting a part of a filter medium as a regular size without a dismantlement of a HEPA filter. This device was able to cut about ten sheets of the filter medium and aluminum separator respectively at just one manual press. And also, it was not difficult to insert a device into the proper position between a pleated filter medium. Therefore, circular samples of a 2 inch diameter from a filter medium were able to be obtained from the intake and the outlet part which showed a high concentration of captured nuclides by using this punch device.

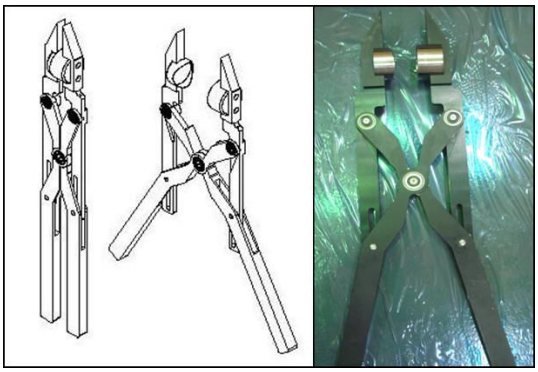

Figure 2. A punch device for taking a representative samples

2.3 Taking a representative sample

In the case of taking a representative sample from a bulk sample, the homogeneity in the whole region has to be secured. However, for a waste of which the homogeneity is not secured, it is possible to take a representative sample at the spots of a high surface dose rate. Therefore, it is desirable to use the second method rather than crushing a HEPA filter to secure a homogeneity.

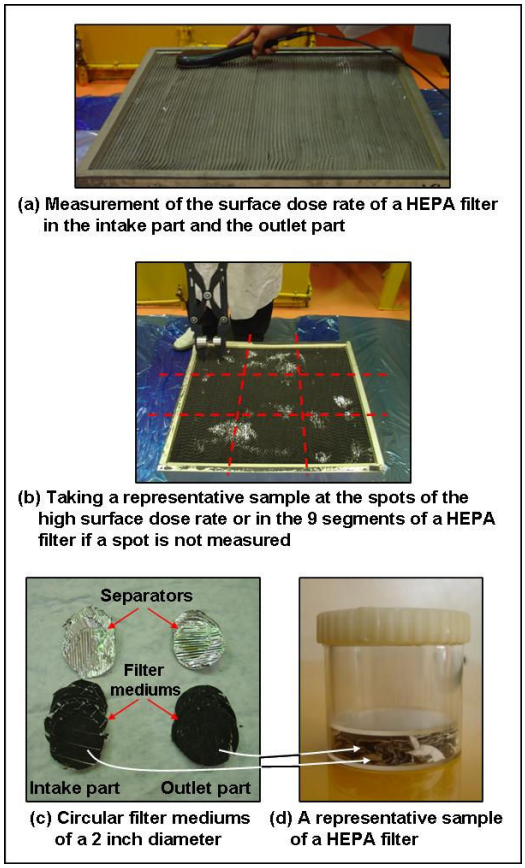

Figure 3. The method for taking a representative sample using a punch device without a dismantlement of a filter

Accordingly, a representative sample of a HEPA filter will be taken at the spot of a high surface dose rate from the intake part and the outlet part respectively. If a spot is not measured, a representative sample was taken from the 9 segments of a HEPA filter, as shown in figure 3. And then, after placing every circular sample into a plastic cylindrical bottle, 20 cc, this bottle could be considered as a representative sample of a HEPA filter for a radioactive analysis.

3. Conclusion

From the results for the depth distribution of the captured nuclides in a filter medium, a HEPA filter showed a regular tendency for its distribution of the captured nuclides in the intake and the outlet part. Therefore, it was possible to utilize this distribution as a guide for taking a representative sample. A punch device was developed to take a representative sample directly from the front side and the rear side of a HEPA filter without a dismantlement. Using this device, circular samples which had a 2 inch diameter were obtained by using the surface dose rate of a HEPA filter. After placing every circular sample into a bottle, this could be considered as a representative sample of a corresponding HEPA filter.

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