Gamma Spectroscopy System With Automatic Sample Feeder in Mobile Laboratory

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1. Introduction

In the process of decommissioning, it is very important to evaluate the radiation characteristics of radioactive waste. In case of nuclear power plant decommissioning project where large amount of radioactive waste can occur, the efficiency of analysis processing is directly related to the time required for decommissioning process, which in turn affects the decommissioning cost. In Korea, it is necessary to analyze 14 radionuclides basically, and additional radionuclide analysis may be required depending on the operation history. Therefore it is necessary to develop the onsite mobile lab and automate the analysis system for alpha, beta and gamma radionuclide. In this study, we designed a gamma spectroscopy system with automatic sample feeder and evaluated the applicability for decommissioning waste.

2. Methods and Results

2.1 Design of the sample feeder

When the radioactive waste is transported from the decommissioning site, it is pulverized and mixed through a crusher and classified using the automated system of separation and sampling for radioactivity level. Some quantities of classified waste are collected as representative samples. These representative samples are transferred to the mobile laboratory to conduct alpha, beta and gamma radioactivity analysis. To increase the analysis efficiency of gamma radioactivity, it is necessary to automate sample change. Therefore, we designed the automatic sample feeder for gamma spectroscopy system as shown in Figure 1.

Fig. 1. Automated sample feeder for gamma spectroscopy system.

Generally, the gamma spectroscopy system enclosed by a thick lead shield to shield the radiation coming from the surrounding environment and satisfy the minimum detectable activity (MDA). And, the lead lid is manually opened and closed to replace the sample in laboratory. However, this manual method has the problem that the analyst has to replace the sample every time the analysis is finished, the analysis processing efficiency may be lowered when the number of sample is large. We made a hole at the upper part of the lead shield and the sample was designed to be vertically replaced by a vacuum pump or a grip.

2.2 Applicability for decommissioning waste

To evaluate the applicability of gamma spectroscopy with automatic sample feeder for decommissioning waste, we checked the space suitability for mobile lab and the minimum detectable activity change by the absence of some lead shielding. As shown in Figure 2, vertical sample exchange is more suitable for mobile laboratory than horizontal sample exchange because of the narrowness of the space.

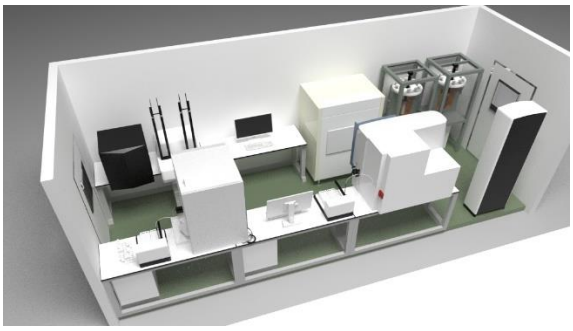

Fig. 2. Space suitability for mobile laboratory.

We evaluated the MDA change according to the degree of lead lid opening and the results are shown in Table 1 using equation (1).[1]

$$MDA = \frac{2.71 + 4.65\sqrt{\mu_B}}{\epsilon \times m \times t} \quad (1)$$

Where, μ_B, ε, m and t are background count, measurement efficiency, sample weight and measurement time, respectively. As shown in results, it is considered that the target MDA for radioactive decommissioning waste can be satisfied.

Table 1. MDA change according to the degree of lead lid opening

Degree of opening	Background increase	MDA increase
100%	5.8	2.4
50%	2.5	1.6
25%	2	1.4

3. Conclusion

In this research, we designed the gamma spectroscopy system with automatic sample feeder and the system are suitable for mobile laboratory of decommissioning onsite.

REFERENCES

[1] L.A Currie, “Limits for qualitative detection and quantitative determination”, Anal. Chem., 40(30), pp.586-593, 1968.