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Quantitative Analysis of Radionuclide for the Used Resin of the Primary Purification System in HANARO

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1. Introduction

In HANARO, a 30 MW research reactor, the ion exchange resin has been used for the purification of the primary coolant system. The resin used in the primary coolant purification system is replaced with new one once every 3 months during 30 MW reactor operation. The extracted resin from the primary coolant purification system is temporarily stored in a shielding treatment of the reactor hall for radiation cooling. After the radiation level of resin decreases enough to be handled for the waste disposal, it is put into the waste drum, and delivered to the waste facility in KAERI. Recently, in this procedure, the quantitative analysis of radionuclide which is contained in resin is required to have more quantitative data for the disposal.

Therefore, in this work, a preliminary study was performed to find a sampling method for the representation of the characteristics of radionuclide in the spent resin.

2. Experimental Methods

The cooling time of the analyzed resin was about 2.5 years. The diameter of the resin cartridge is 53 cm, and the volume of the contained ion exchange resin was 26.1 liters. The small amount of resin was picked up in several spots in the cartridge places for sampling by using special tool. The total number of sampling was 18 points. 9 dry samples were collected on the upper part and 9 wet samples were collected on the lower part.

The radionuclides in the used resin were analyzed by the detection of the gamma-rays from it with the HPGe detector. The absolute activity of each radioduclide in the resin was determined by using the standard source calibration[1,2].

3. Results

Table 1 and 2 represent the measured specific activities of the radionuclide in resin sample collected at each position. The radionuclide found in the spent resin were Co-60, Cs-134, Cs-137, Eu-154, Eu-155, Mn-54, Sb-125, Zn-65, Ce-144 and its daughter Pr-144. The representative radionuclide in the used resin was Co-60.

In the dry resin, the composition of the radionuclide was very different for each sample. But, in the wet resin, the composition is similar for each sample.

Figure 1, 2 show the measured specific activity distributions of Co-60 on the sampling planes. From the figures, we can see that the activity in the wet position is much higher than that in the dry position which is upper part. Therefore, it is confirmed that the main activity contribution is from the wet part of resin.

Based on this study, a sampling method the representation of the spent resin characteristics will be sought.

REFERENCES

[1] R. G. Helmer, "Gamma- and X-ray Spectrometry with Semiconductor Detectors", North-Holland, 1988.
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[3] Han-seok Cho etc., "A Study on the Statistical Representa -tiveness of Samples taken from Radioactive Soil", Korean Radioactive Waste Society, 2005.
[4] Han-seok Cho etc., "Radioactivity Analysis of Soils Stored in KAERI for Regulatory Clearance", Korean Radioactive Waste Society, 2005.

Table 1. Measured activities of each nuclide from upper part.

Radio-nuclide	Measured activities($\times 10^{-3}$ μCi/g) – Upper part								
	U1	U2	U3	U4	U5	U6	U7	U8	U9
Ce-144	4.22	3.55	3.62	3.18	3.15	3.31	3.26	3.20	3.37
Co-60	5.19	19.3	12.30	2.18	4.96	2.15	2.78	11.6	21.2
Cs-134	1.01	0.12	0.38	0.39	0.40	0.43	0.02	0.06	0.11
Cs-137	7.07	0.97	0.61	0.09	0.23	0.09	0.12	0.57	1.03
Eu-154	0.20	0.24	0.28	0.20	0.25	0.24	0.21	0.19	0.22
Eu-155	0.19	0.15	0.19	0.18	0.17	0.89	0.17	0.16	0.15
Mn-54	0.31	1.49	1.02	0.16	0.37	0.16	0.20	0.93	1.57
Sb-125	0.40	7.16	7.34	7.30	7.16	7.88	6.99	6.98	6.74
Zn-65	1.89	5.98	3.93	0.64	1.51	0.63	0.82	3.60	6.63

Table 2. Measured activities of each nuclide from lower part.

Radio-nuclide	Measured activities(10-3 μ Ci/g) – Lower part								
	L1	L2	L3	L4	L5	L6	L7	L8	L9
Ce-144	8.32	7.71	8.88	7.32	8.36	7.88	8.77	8.65	7.83
Co-60	153	170	193	160	216	168	186	190	194
Cs-134	0.53	0.50	0.37	0.46	0.64	0.53	0.69	0.45	0.58
Cs-137	5.51	5.25	6.02	4.95	6.34	5.00	5.58	5.85	5.99
Eu-154	0.88	-	-	-	0.41	-	-	0.46	-
Eu-155	0.41	0.56	0.24	0.39	0.51	0.38	0.46	0.56	0.49
Mn-54	11.6	11.9	14.2	11.4	16.1	12.9	13.7	14.2	14.9
Sb-125	5.98	6.11	6.63	5.61	6.53	6.31	6.35	7.88	6.61
Zn-65	43.5	49.1	54.7	43.7	57.0	48.1	50.5	55.1	53.3

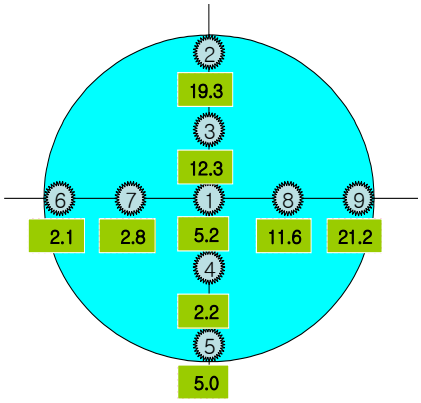

Fig. 1. Measured specific activity distributions of Co-60 on the upper plane.

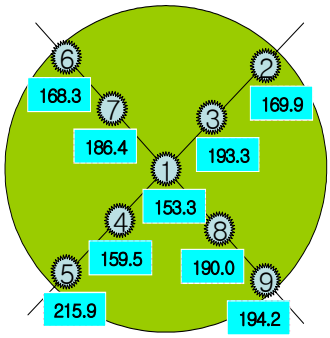

Fig. 2. Measured specific activity distributions of Co-60 on the lower plane.