Measurement and Analysis of Air sample for Radioactivity in Airborne dusts

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1. Introduction

KOMAC has been operating a 100-meV and 20-meV accelerator beamline since in 2013. Because the Accelerator operation produce secondary particle which could be activating and surrounding material, the air activity concentration and ionizing radiation should be monitored in the radiation controlled area and the general working area. [1] In order to monitor the activation air concentration, the air particulate collected by the air sampler (Hi-Q) is to evaluate the radioactivity using the low background alpha/beta counter. So, measure the radioactivity of the air samples in the facility and confirm the change of the airborne radioactivity value with the lapse of time so investigate whether airborne radioactivity by artificial radionuclides occurs. [2] In this paper, we introduce the method of air concentration measurement.

2. Methods and Results

Prior to the collection and measurement of air samples in the facility, efficiency calibration was performed on the low energy alpha beta counter used as the analytical equipment. Efficiency calibration was performed by using standard source and calibration of efficiency using standard samples. The lower value of the two efficiencies was chosen as the conservative efficiency of the air sample measurement.

2.1 Detector calibration

The background measurement for instrument efficiency calibration using a standard source is carried out and the operating voltage and plateau are measured using Am-241 and Sr-90 as standard sources and checked the calculated efficiency value is checked. In the calibration of equipment using standard samples, the high purity KCL powder is used for calibration as standard source for the calibration. Since air dust has a small difference in the amount of the sample and the amount of the air dust is as small as several milligrams, the standard sample is made with the same weight. For sample preparation, 1.5g of KCl powder is added in a 50ml beaker. After adding 20g of distilled water, the KCl powder is dissolved. The KCL solution is weighed 1.0 g, 1.5 g, and 2.0 g into the air filter paper of the planchette. Figure 1 shows the preparation of standard samples.

Fig. 1. Preparation of standard samples and measurement equipment (Low background α/βcounter, 5 XLB)

After uniformly applied and completely evaporated, three samples are completed. The evaporated air filter samples were measured three times for 60 minutes each with a low background alpha and beta counter. The radioactivity (dpm) for the weight of the KCl standard sample is N_k = 0.887xW. W is the weight of KCl (mg), and 0.887 dpm / mg is the Beta release rate of 1 mg of KCl. Therefore, using the above equation, the radioactivity concentration for each solution is 61.884dpm, 92.83dpm, and 123.77dpm. The average of the measured values for each weight is obtained. If the efficiencies of the three samples are within 20% of each other, all three samples are averaged. This average value is selected as the efficiency for the air dust filter. The measurement results are summarized in Table 1.

Table I: Measurement results of standard samples

KCl weight	Standard filter sample	Measurement condition
1.0g	61.88 dpm	3 times every 60 minute
1.5g	92.83 dpm	3 times every 60 minute
2g	123.77 dpm	3 times every 60 minute

After comparing the efficiencies of the three samples, it was confirmed that they were within 20% of each other, and the average value of the efficiencies was obtained. As a result of the two efficiency calibration methods, lower values were selected and used for air sample analysis as conservative efficiency.

2.2 Measurement air sample

In order to collect air samples, an air sampler with a

filter was installed in front of the waiting room where people were frequently accessed and the air-sampler collected during 1 hour with 60LPM. Figure 3 shows an air-sampler placed at the measurement site.

Figure. 2. Replacement of air sampler

The collected samples were measured 9 times for 5 minutes at appropriate intervals to obtain the decay constants of the radioactivity on the filter using the low background alpha and beta counter (5XLB). [3] The measurement conditions and values of the air samples are summarized as shown in Table 2 below.

Table Ⅱ: Measurement conditions and values of the air sample

Times	Interval time (min)	Lapsed time (h)	Alpha (Bq/m3)	Beta (Bq/m3)
0	0	0.0	9.25	26.88
1	8	0.13	8.17	23.74
2	18	0.30	7.21	20.09
3	29	0.48	6.31	16.64
4	40	0.67	5.78	14.05
5	67	1.12	3.45	8.38
6	1402	23.37	0.07	0.35
7	1049	65.48	0.05	0.19
8	45	72.75	0.07	0.19
9	1074	89.90	0.01	0.08

As a result of the measurement, it was confirmed that the radioactivity value decreased rapidly after about 20 hours and remained very low. The value of "0" times is the radioactivity of air sample immediately after collection. After 72 hours, the air sample was measured and its value of beta radioactivity was 0.08 Bq /m3.

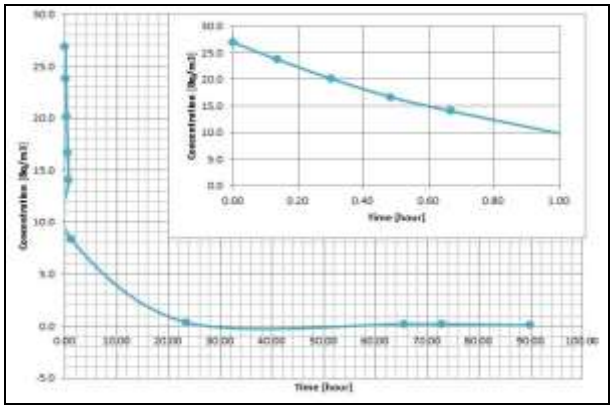

Figure 3. Radioactivity (Beta) decay curve of air sample with lapsed time

Figure 3 shows the decay curve of radioactivity (Beta) of air sample with the lapse of time.
Considering that natural radioactivity is sufficiently attenuated, it can be concluded that there is little effect of airborne radioactivity on artificial radionuclides.

3. Conclusions

In the radiation controlled area and the general working area are of KOMAC, the air samples were takes using the air-sampler and have measured using the low alpha-beta counter in order to check the change trend of the radioactivity value with time and determine whether radioactivity is produced from the artificial radionuclides. As the measurement result, the air concentration calculated after 72 hours of air sample collection would be 0.08 Bq/m^3. Since the natural radioactivity is sufficiently attenuated, it is confirmed that there is almost no effect of air contamination on artificial radionuclides.

REFERENCES

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