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The Periodic Measurement of the Airborne Radioactivity In Controlled Area of KOMAC

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1. Introduction

Korea Multipurpose Accelerator Complex (KOMAC) to start the performance operation in the second half of 2013, is currently operated in each beamline 20-MeV and 100-MeV. The accelerator operation period is simply divided by three operation cycles which are the maintenance checks period for accelerator device, the performance test period before driving accelerator and the operation period. During this operation period, beam is irradiated to target. At this time, the proton beams collide with the target material and a high dose of radiations such as gamma ray and neutron occurred.

After the beam is turned off, the residual radioactivity in the target materials is remained. The air radiation activation also occurs in the target room. Radiation controlled area at the accelerator facility is divided into accelerator tunnel and beam utilization zone. Sample preparation and experiment are mostly conducted in the preparation room in the beam utilization zone. Fig.1 shows the accelerator tunnel.

Figure. 1. Accelerator in the tunnel area

Target room and preparation room is divided by shielding door of 2m thick as boundary which is consists of concrete and lead materials. In the KOMAC, the radiation monitoring through the Radiation Monitoring System (RMS) which is remote and real-time monitoring system is conducted and each zone in the controlled area directly is measured using a survey meters.

Radioactivity is measured by dividing the proceeds of the surface contamination using a smear method and air contamination inspection with air sampler. This paper shows how the contamination test in the accelerator facility is done by carrying out the measurement of airborne contamination in accordance with the accelearator operation periods.

2. Experiment

Air sampling inside the accelerator beam facility was conducted during the beam irradiation period under the accelerator operation and maintenance period of the acceleration device and performance operation test period. Measurement location is largely divided into public area, boundary of public areas and controlled areas. The detailed location is based on where the workers mostly reside zone. Designated public area is near the accelerator control room. Controlled area is divided into 20-MeV and 100-MeV preparation room, accelerator tunnel entrance and controlled area entrance. The air samples were collected by operating the air sampler at these zones. Figure.2 shows setting an air sampler and operation which is collected air samples from the 20-MeV preparation room

Figure. 2 Operating air sampler

Air samples collecting were conducted each three operation cycles (maintenance, performance test, operation). On accelerator operation cycle, air sampling was carried out once each 20-MeV, 45-MeV, 100-MeV beam irradiation period. Air samplers were running during 10 minutes after the sample paper is mounted in the equipment. After finished the measurement, the air sample papers were loaded into Low background alpha and beta counter. .Measurement in the counter was repeated five times for 5 minutes per sample and then the average of the measured radioactivity data from the counter is calculated and it was converted to a value per unit area [Bq / m^3].

3. Result

In general, airborne radioactive is identified by reference to the value of the indoor air radon concentration. Measurement results show that very low levels of indoor radon recommendation value than 148 Bq/m^3 at multiple facilities.[1][2] Figure. 3 and 4 show comparison of the measured values about alpha and beta for each operating cycle of the accelerator.

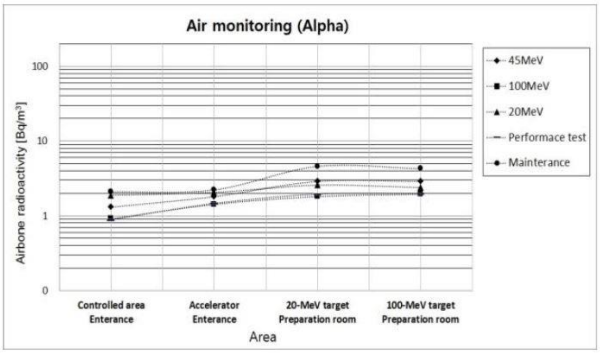

Figure 3 Airborne α-radioactivity

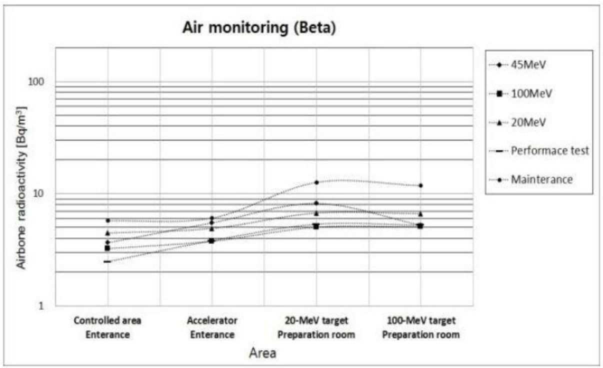

Figure 4 Airborne β-radioactivity

During the maintenance period, all shielding doors were opened for inspection devices in the controlled area. Therefore, the residual air is inside the room that flows to a different target area, the air sample values were measured slightly higher than other periods.

In addition, during the operation and maintenance periods, radioactivity of the accelerator tunnel (near the ion source) and 100-MeV target room was also measured as same method. The measurement results are summarized in Table. 1 and Table. 2

Table. 1. Airborne radioactivity value of operation period

Measurement Area	Alpha (Bq/m^3)	Alpha Unc	Beta (Bq/m^3)	Beta Unc
Accelerator Tunnel (Near the Ion source)	1.23	0.48	3.38	0.83
100-MeV Target room	2.03	0.57	5.59	1.40

Table. 2. Airborne radioactivity value of Measurement period

Measurement Area	Alpha (Bq/m^3)	Alpha Unc	Beta (Bq/m^3)	Beta Unc
Accelerator Tunnel (Ion source)	1.13	0.37	3.14	0.75
100-MeV Target room	3.23	1.00	8.70	2.14

As a result of measuring a target room and inside the tunnel, it was also confirmed that very low levels of indoor radon than the recommendation value. And when compared to measurements, it does not significantly differ from other measured zones in controlled area

4. Conclusion

As a result of measuring the airborne radioactivity in the controlled area in accordance with the operating cycle of the proton accelerator KOMAC, It was confirmed that the value of the airborne radioactivity does not significantly differ according to each accelerator operating cycles. And alpha and beta values measured inside the area that workers primarily work is very low indoor radon level than the value of the recommendations in multiple facilities.

Reference

[1] www.me.go.kr

[2] A Study of Radon Concentration in First Floor and Basement and Prediction of Annual Exposure Rate in Korea, Department of Environmental Health Science, Soonchunhyang University, Korea/ Environmental Epidemiology Division, NIER , Incheon, Korea/ Institute of environmental & Industrial Medicine, Hanyaung University, Seoul/Jong-Dea Lee, Yoon-Shin Kim, Bu-Soon Son and Dae-Seon kim