Inovasi Teknik Kimia. Vol. 7, No.2, Oktober 2022, Hal 5-8 ISSN 2527-614X, e-ISSN 2541-5891

EVALUATION OF AIR RADIOACTIVITY MONITORING IN RADIOMETALLURGICAL INSTALLATION

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Abstrak

Pemantauan udara buang dilakukan dengan menggunakan alat pantau udara buang kontinu, yaitu alat SmartCAM yang masing-masing terpasang di Cerobong Gedung Instalasi Radiometalurgi (IRM) dan kemudian dilakukan evaluasi data udara buang setiap bulan nya selama tahun 2020. Tujuan dari penelitian pemantauan udara buang adalah untuk mengetahui radioaktivitas dan yang dilepaskan dari cerobong IRM ke lingkungan selama tahun 2020. Data yang diambil berupa nilai konsentrasi gross alpha (α) dan gross beta (β) di IRM. Data yang telah diperoleh tersebut kemudian diolah untuk mencari nilai rata-rata hariannya, kemudian diambil nilai rata-rata tertingginya dalam satu bulan. Hasil yang diperoleh untuk tiap bulannya kemudian dibandingkan dengan Maximum Permissible Concentration (MPC) untuk gross α and gross β. Hasil evaluasi data menunjukkan bahwa nilai lepasan udara buang selama tahun 2020 di IRM adalah sebesar 0,324 Bq/m3 dan 6,342 Bq/m3 untuk alfa dan beta. Besaran konsentrasi radiasi alfa dan beta udara buang IRM pada tahun 2020 tersebut jika dibandingkan dengan MPC yaitu 2 Bq/m3 untuk α dan 20 Bq/m3 untuk β, batasan pelepasan maksimum IRM masih jauh di bawah batas maksimum yang diijinkan, dari hasil ini dapat dikatakan bahwa efluen gas/aerosol radioaktif yang dilepas dari cerobong IRM selama tahun 2020 tidak menimbulkan dampak radiologi dan aman bagi masyarakat serta lingkungan disekitar gedung IRM.

***Kata kunci**: udara buang, IRM, zat radiaoktif*

Abstrak

Air radioactivity monitoring was carried out using a continuoust air radioactivity monitoring device, namely the SMARTCAM device, each of which was installed in the chimney of the Radiometallurgical Installation (RMI) Building and then an evaluation of the air radioactivity data was carried out every month during 2020. The purpose of this research about air monitoring was to determine the radioactivity and release from the RMI chimney to the environment during 2020. The data taken are gross alpha (α) and gross beta (β)concentrations at the RMI. The data that has been obtained is then processed to find the daily average value, then the highest average value is taken in one month. The results obtained for each month are then compared with Maximum Permissible Concentration (MPC) for the predetermined gross α and gross β. The results of data evaluation is shown that the air radioactivity monitoring during 2020 at RMI is 0.324 Bq/m3 for alpha and 6.342 Bq/m3 for beta . The amount of air radioactivity of RMI in 2020 when compared to the MPC of 2 Bq/m3 for alpha and 20 Bq/m3 for beta, the air radioactivity is still far below the maximum allowable limit, from these results it can be said that the radioactive gas/aerosol effluent released from the RMI chimney during 2020 did not cause radiological impacts and was safe for the community and the environment around the RMI building.

***Kata kunci**: air radioactivity, RMI, radioactive material*

1. INTODUCTION

Radiometallurgical Installation (RMI) is an installation that functions as a place for research and development of nuclear fuel technology. The function of RMI is to carry out post irradiation test activities for nuclear fuel (post irradiation examination), starting from the acceptance of spent fuel, non-destructive tests, destructive tests, preparation of samples for chemical and physical analysis. (Suliyanto, 2010)

Most of the spent fuel is inside the hot cell, only a small sample is transferred to the outside of the hot cell, especially for the purposes of chemical analysis (burn-up analysis), spectrometry, SEM and TEM. The Radiometallurgical Installation Facility also consists of a laboratory and a Media & Energy Supply (MES) building. (Susanto, 2009)

Radiation sources managed by RMI for nuclear fuel development activities are U (depleted, natural, and enriched) materials in various physical and chemical forms as well as radioactive substances in the form of fission products from nuclear reactors such as Cs-137. Based on the current research and development process, large amounts of natural Uranium are used, while depleted Uranium and enriched Uranium are used in limited quantities and are standard materials. The uranium material used in the fuel R&D has internal radiation hazards by emitting alpha radiation and also emits a small amount of gamma/external radiation, while radioactive substances such as Cs-137, apart from having internal radiation hazards, also have the potential for external radiation. (Wahyuningsih, 2018).

The waste gas or radioactive particles released into the atmosphere will be spread by the wind and will eventually reach the communities around the nuclear installation through various intermediate cycles, namely through the cycle of inhalation, immersion, and exposure to the ground surface. This will increase dose acceptance both internally and externally to members of the public. Therefore, if the discharge of gas or particulate matter is not limited and not monitored, it will reduce the quality of the environment and in turn will reduce the level of public health. (Nudia, 2013), (Anthony, 201), (Sukirno, 2016).

To prevent/reduce the release of radioactive substances before they are released into the air, ventilation and air conditioning (VAC) systems are installed in both buildings. The function of this system is to organize the movement of air from areas of low contamination potential to areas of higher contamination potential. Another function of the ventilation system is for worker comfort. Through proper airflow regulation, the danger of contamination can be reduced or eliminated.

The airflow system used is a once-through system, which is to regulate the air with only one pass. In this system, outside air is supplied with a supply fan at a discharge of 100%. Without re-circulation, the incoming air is then completely discharged through the exhaust air system. To maintain the cleanliness of the room, the incoming air is filtered first by passing it through a row of filters (supply filter bank), This filter also functions to extend the life of the exhaust air filter.

Air radioactivity in RMI is discharged through a chimney with a diameter of 2 m with a chimney height of 60 m above the ground. Based on the design, the airflow capacity (discharge) through the chimney is 14,277 m^3/hour.

Air radioactivity through the chimney (stack) in this environment must always be monitored for radioactivity. Before being discharged through the chimney, the air is filtered using a HEPA (High Efficiency Particulate Air) filter which has a minimum filtration efficiency of 99.97% for particulates with a diameter of 0.3 m. (Darojad, 2018) In order to control the release of air into the environment so as not to pose a hazard to the environment, the Safety Division at PTBBN always conducts routine monitoring and documentation either automatically, by using the SMARTCAM (Spectral Measurement Analysis in Real Time Continuous Air Monitor) tool , or manually, with an air sampling device. (Wahyuningsih, 2009)

The problem discussed in this monitoring activity is waste gas/aerosol carried by the RMI ventilation system and filtered using air contaminant collection media in the form of a HEPA filter. The air radioactivity contains radioactive particulates formed during the post-irradiation test process. The radioactive particulates will be directly channeled into the exhaust ducting system, all of which will be passed to a layered or multi-layered HEPA filter. The flow of Air Radioacitivity Monitoring in RMI can be seen in Figure 1. Air measurement data is obtained by modeling, calculating to estimating released emissions. However, this study is limited to the results of the data generated by SMART CAM.

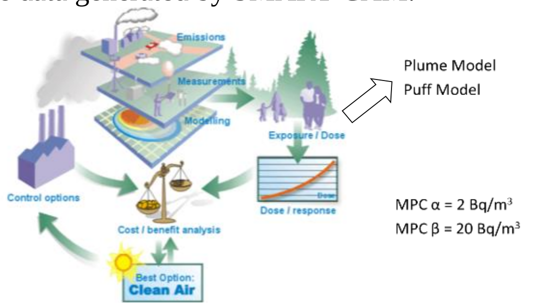

Figure 1. Air Radioactivity Monitoring Flow in RMI (Christoper, 2020)

The aim of the air radioactivity monitoring study was to determine the radioactivity and release from RMI stacks to the environment during 2020. (Sukesi, 2015)

2. METHODOLOGY

The air coming from the chimney is sucked in with a suction pump attached to the Smartcam with an average flow rate of 39 lpm. The air is captured on speclon type filter paper which will change automatically (moving filter), then the tool will count automatically and will generate data in real time. The data to be calculated is taken by opening the microsoft explorer program on a computer connected to the Smartcam tool.

The data is stored in the datalog file of the Smartcam tool. Then the data is downloaded and stored in a special folder on the computer as data backup. The data for RMI taken are gross α and gross β radioactivity data. Consideration of the type of radioactivity calculated for each installation is based on the type of activity carried out in the laboratory and the materials used. In RMI, a lot of post-irradiation analysis/testing of used reactor fuel is carried out so that the released radioactivity will be more dominant in alpha and beta. Next, the average value is calculated for each daily data using the Microsoft Excel program. From the results of these calculations, then data is taken with the largest average value for each month. Then the data is evaluated by comparing it with the existing/applicable limit values as written in table 1.

Tabel 1. Maximum Permissible Concentration (MPC) (Latief 2010) (Sukesi, 2019)

Chimney Position	MPC
RMI	Rad α : < 2 Bq/m^3 Rad β : < 20 Bq/m^3

3. RESULTS AND DISCUSSION

Air radioactivity monitoring data are shown in Graph 1 and Graph 2. The graphs explain the calculation of the highest average air radioactivity in RMI for each month in 2020.

Data Monitoring results on the graph obtained are the concentration of radioactivity in air radioactivity for gross α and gross β, which is a combination of air radioactivity from laboratory lines, fumehood lines, and hot cell lines.

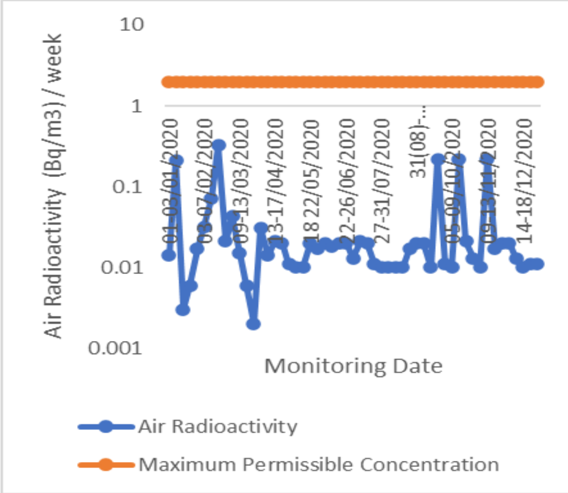

Figure 2. Results of Air Radioactivity Monitoring (gross α) January – December 2020 at RMI

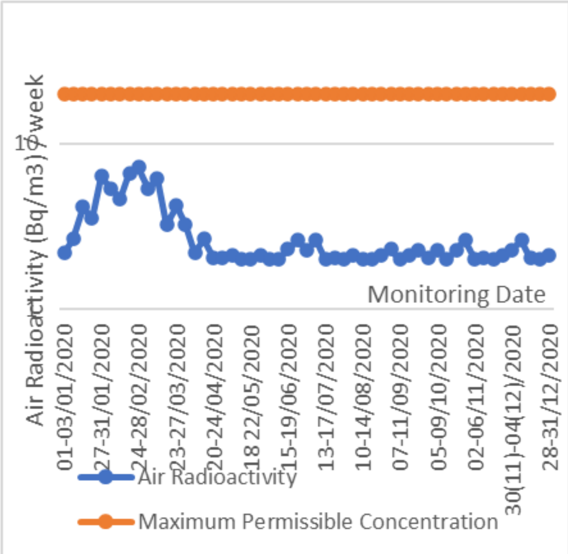

Figure 2. Results of Air Radioactivity Monitoring (gross β) January – December 2020 at RMI

The highest concentration of RMI air radioactivity during 2020, for α radiation is of 0.324 Bq/m^3 is seen in Figure-1 while for β radiation is of 6.342 Bq/m^3 can be seen in Figure 2. The average concentration of α radioactivity in the air is (0.038 ± 0.066) Bq/m^3 and the average concentration of β radioactivity in the air is (2.813 ± 1.351) Bq/m^3. The amount of radiation concentration and of RMI air radioactivity in 2020 when compared to the Maximum Permissible Concentration (MPC). Maximum air radioactivity of the RMI stack is still far below the maximum allowable limit, which is 2 Bq/m^3 for α and 20 Bq/m^3 for β.

The increase in and radiation was caused by, among other things, weighing and measuring samples from the Criminal Investigation Department and BAPETEN for forensics and also influenced by research activities in rooms 135, 136 and 137.

The radiation caught in the filter is in the form of dust particles that are retained in the filter paper on the SMART CAM device. After passing through the HEPA filter, the air radioactivity is released into the environment at a stack height of 60 m and is filtered in the HEPA Filter. With this height there will be a very large dilution of the concentration of radioactivity α and β. The dilution will cause the concentration of and radioactivity released to the environment to be smaller, so that the reception of radiation to the environment and the public does not cause radiological impacts. However, radionuclide analysis is needed to determine the type of radionuclide released.

4. CONCLUSION

The highest air radioactivity concentration during 2020 was for α radiation of 0.324 Bq/m^3 while for β radiation was 6.342 Bq/m^3. The amount of radiation concentration and of the highest RMI air radioactivity in 2020 when compared to MPC. Maximum air radioactivity of the RMI stack is still far below the maximum allowable limit, from this result it can be said that the radioactive gas/aerosol effluent released from the RMI chimney during 2020 does not cause radiological impacts and is safe for the community and the environment around the RMI building.

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