



EXPOSURE TO AIRBORNE PARTICULATE MATTER IN THE RADIOACTIVE WASTE STORAGE FACILITY

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1. Background

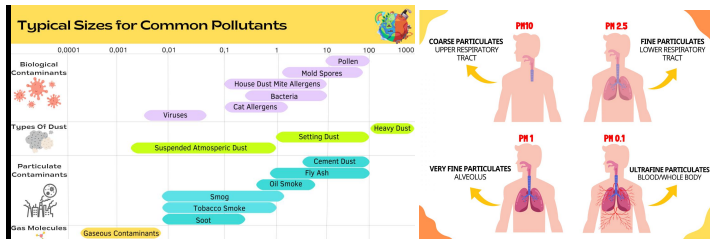
The radioactive waste storage facility in Radioactive Waste Management Installation (RWMI) is closely related to airborne particulate matter. The radioactivity concentration and air contamination level in particulate matter must be analyzed and compared with the required limitation. Monitoring air contamination levels is a commitment based on the Safety Analysis Report (SAR) of RWMI. We must monitor exposure to airborne particulate matter because of the very high potential in our activities, and it's become an important issue to workers' health. Monitoring exposure to airborne particulate matter also needs attention because it has objectives closely related to sustainability and safety, such as protecting human health (safety), preventing environmental impact (safety and sustainability), and measuring regulatory compliance.

2. Introduction

The RWMI is the only radioactive waste management installation in Indonesia. The RWMI carries out various radioactive waste management activities such as solid waste preparation, cementation, direct immobilization, compaction, incineration, evaporation, and ion exchange. The RWMI has several radioactive waste storage facilities, including Interim Storage 1 (IS-1) and Interim Storage 2 (IS-2).



Dust particulates mixed with particulate matter in the air can produce particulate pollutants that can enter the human body through the respiratory system and harm the respiratory system.



Typical Sizes for Common Pollutants and Particles Passing Through the Human Respiratory System

3. Regulation

- Ministry of Manpower Regulation No. 5 of 2018: Occupational Safety and Health in the Work Environment, the Threshold Value (TLV) of respirable particulates can't exceed 2 mg/m³.
- SNI 19-0232-2005: The TLV is a hazard factor standard in the workplace as a guideline for control so that workers can still deal with them without causing illness or health problems in their daily work for no more than 8 hours a day or 40 hours a week.
- ISO 14644-1: 2015: The clean rooms and related controlled environments, especially regarding the classification of air cleanliness based on particle concentration.

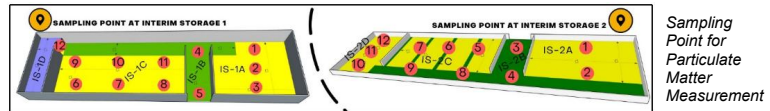
| ISO 14644-1:2015 Classification Number (N) | Maximum Concentration Limits (Particles/m ³) | | | | |
|--|--|---------|---------|------------|-----------|
| | 0.1 | 0.2 | 0.3 μm | 0.5 | 1.0 |
| | In the micrometer range | | | | |
| ISO Class 1 | 10 | | | | |
| ISO Class 2 | 100 | 24 | 10 | | |
| ISO Class 3 | 1 000 | 237 | 102 | 35 | |
| ISO Class 4 | 10 000 | 2 370 | 1 020 | 352 | 83 |
| ISO Class 5 | 100 000 | 23 700 | 10 200 | 3 520 | 832 |
| ISO Class 6 | 1 000 000 | 237 000 | 102 000 | 35 200 | 8 320 |
| ISO Class 7 | | | | 352 000 | 83 200 |
| ISO Class 8 | | | | 3 520 000 | 832 000 |
| ISO Class 9 | | | | 35 200 000 | 8 320 000 |

- The Safety Analysis Report (SAR) of RWMI, regarding work distribution area and limits of air contamination level in RWMI.

| Room Codes | Room Names | Work Area | | Control Area | Limitation |
|------------|--|-------------------|--------------|--|---|
| | | Super-Vision Area | Control Area | | |
| IS-1A | IS-1 storage of unprocessed radioactive waste IS-1 entrance corridor IS-1 storage of concrete shell | ✓ | ✓ | Low Contamination | alpha < 0.6 Bq/m ³ and beta < 6 Bq/m ³ |
| IS-1B | | ✓ | ✓ | | |
| IS-1C | | ✓ | ✓ | | |
| IS-1D | IS-1 storage of contaminated waste material (HEPA filter) and used radioactive sources have not been conditioned | ✓ | ✓ | Medium Contamination | 0.6 ≤ alpha < 6 Bq/m ³ and 6 ≤ beta < 60 Bq/m ³ |
| IS-2A | | ✓ | ✓ | | |
| IS-2B | IS-2 storage of nuclear waste IS-2 entrance corridor | ✓ | ✓ | Work Distribution Area and Limitation of limits of air contamination level in RWMI | |
| IS-2C | | ✓ | ✓ | | |
| IS-2D | IS-2 storage of processed waste in 200 L drums and deposited radioactive sources | ✓ | ✓ | | |
| IS-2D | IS-2 storage of used radioactive sources categories 1-2 and 3-5 large dimensions | ✓ | ✓ | | |

4. Method

Determine the sampling points for particulate matter measurement in IS-1 and IS-2, then operate the particulate counter meter at each sampling point with a height of 150 cm from the floor.



5. Result

5.1. Measurement of the Particulate Amount in the Radioactive Waste Storage Facility of RWMI

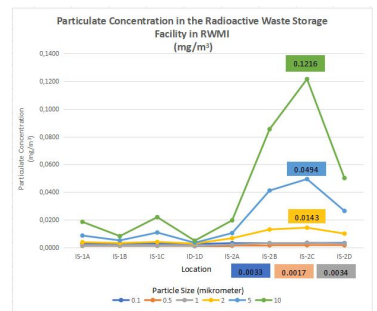
| No | Location | Particulate Amount (particle/m ³) | | | |
|---------|----------|---|--------|-------|-------|
| | | 0.3 | 0.5 | 5 | 10 |
| 1 | IS-1A | 264,815 | 25,150 | 3,290 | 1,123 |
| | | 269,086 | 25,417 | 3,337 | 1,139 |
| | | 269,612 | 25,498 | 3,337 | 1,225 |
| | | 267,638 | 25,355 | 3,321 | 1,162 |
| | | 267,023 | 25,286 | 3,009 | 1,003 |
| Average | 266,635 | 25,412 | 3,064 | 1,037 | |
| 2 | IS-1B | 253,199 | 22,987 | 3,356 | 1,295 |
| | | 260,395 | 23,763 | 3,220 | 1,190 |
| | | 280,228 | 24,020 | 3,310 | 1,218 |
| | | 261,327 | 23,806 | 2,964 | 998 |
| | | 270,803 | 26,238 | 3,174 | 1,015 |
| Average | 269,434 | 26,045 | 3,142 | 1,005 | |
| 3 | IS-1C | 291,291 | 29,099 | 4,718 | 1,737 |
| | | 293,248 | 24,473 | 3,944 | 1,120 |
| | | 253,248 | 22,310 | 2,805 | 894 |
| | | 253,248 | 22,310 | 2,805 | 894 |
| | | 291,767 | 30,330 | 5,583 | 2,142 |
| Average | 291,529 | 29,714 | 5,150 | 1,969 | |
| 4 | IS-1D | 287,395 | 32,866 | 8,269 | 4,140 |
| | | 279,296 | 28,236 | 4,917 | 1,827 |
| | | 283,345 | 30,551 | 6,593 | 2,964 |
| | | 291,529 | 29,714 | 5,150 | 1,969 |
| | | 287,395 | 32,866 | 8,269 | 4,140 |
| Average | 287,395 | 32,866 | 8,269 | 4,140 | |
| 5 | IS-2A | 291,291 | 29,099 | 4,718 | 1,737 |
| | | 293,248 | 24,473 | 3,944 | 1,120 |
| | | 253,248 | 22,310 | 2,805 | 894 |
| | | 253,248 | 22,310 | 2,805 | 894 |
| | | 291,767 | 30,330 | 5,583 | 2,142 |
| Average | 291,529 | 29,714 | 5,150 | 1,969 | |
| 6 | IS-2B | 287,395 | 32,866 | 8,269 | 4,140 |
| | | 279,296 | 28,236 | 4,917 | 1,827 |
| | | 283,345 | 30,551 | 6,593 | 2,964 |
| | | 291,529 | 29,714 | 5,150 | 1,969 |
| | | 287,395 | 32,866 | 8,269 | 4,140 |
| Average | 287,395 | 32,866 | 8,269 | 4,140 | |
| 7 | IS-2C | 308,102 | 31,516 | 5,603 | 2,592 |
| | | 303,209 | 36,118 | 8,865 | 4,537 |
| | | 296,058 | 34,658 | 8,518 | 4,368 |
| | | 296,136 | 33,775 | 7,780 | 3,823 |
| | | 303,338 | 34,048 | 7,656 | 3,878 |
| Average | 291,906 | 32,817 | 7,091 | 3,093 | |
| 8 | IS-2D | 292,592 | 32,615 | 6,971 | 3,188 |
| | | 290,993 | 33,420 | 7,393 | 3,169 |
| | | 292,133 | 32,416 | 6,909 | 2,927 |
| | | 291,506 | 32,817 | 7,091 | 3,093 |
| | | 292,592 | 32,615 | 6,971 | 3,188 |
| Average | 291,906 | 32,817 | 7,091 | 3,093 | |

Particulate Amount in the Radioactive Waste Storage Facility of RWMI in Semester 1 2023.

The radioactive waste storage facility of RWMI complies with ISO Class 7 classification, with a particle size limit of ≥0.5 micrometer is 352,000.

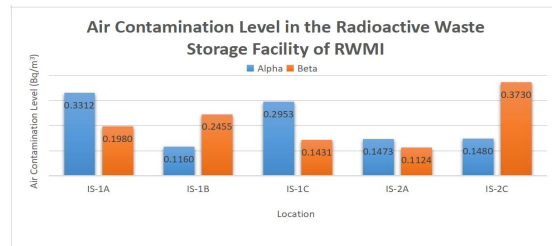
5.2. Measurement of Particulate Concentration in the Radioactive Waste Storage Facility of RWMI

Particulate Concentration in the Radioactive Waste Storage Facility of RWMI in Semester 1 2023.



The largest particulate concentration for each particle size are in the IS-2C, the most significant particulate is particle size 10 micrometer with the particulate concentration 0.1216 mg/m³, but it is below the TLV.

5.3. Measurement of Air Contamination Level in the Radioactive Waste Storage Facility of RWMI



The highest level of air contamination for alpha is 0.3312 Bq/m³, and beta is 0.3730 Bq/m³. These two values are within the limits of the low contamination area.

Air Contamination Level in the Radioactive Waste Storage Facility of RWMI from January to June 2023

6. Conclusions and Acknowledgements

The conclusion of this poster is measuring results of the amount of particulate matter in the radioactive waste storage facility of RWMI comply with ISO 14644-1:2015 Class 7; the concentration result of particulate matter in the radioactive waste storage facility of RWMI is below the TLV determined in the Ministry of Manpower Regulation Number 5 of 2018 concerning Occupational Safety and Health in the Work Environment; the level of air contamination in the radioactive waste storage facility of RWMI is within the low contamination area limits according to the SAR document of RWMI; the dust control and usage of PPE, such as masks, must be continuously carried out considering the dangers of dust, which can cause health problems; and monitoring activities are urgently needed per activity period

Thanks to the Occupational Safety Division and Treatment Operations Division of RWMI for the participation and cooperation.

International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation: Ensuring Safety and Enabling Sustainability, CN-318 Vienna, Austria; 6-10 November 2023