

# A High Resolution Aerosol Database Design for Analysis of Radioactive Aerosol during Decommissioning of NPPs

Hyunjin Bo<sup>a</sup>, Min-Ho Lee<sup>b</sup>, Hee Kwon Ku<sup>b</sup>, Hwa Jeong Han<sup>a</sup>, Jonghyeon Kim<sup>a</sup>, Byung Gi Park<sup>a\*</sup>

<sup>a</sup>Department of Energy and Environmental Engineering, Soonchunhyang University, 22 Soonchunhyang-ro, Asan-si, Chungcheongnam-do, 31538, Republic of Korea

<sup>b</sup>FNC Technology Co. Ltd., Institute of Future Energy Technology, 46 Tapsil-ro, Giheun-gu, Yongin-si, Gyeonggi-do, 17084, Republic of Korea

\*Corresponding author: byunggi@sch.ac.kr

## 1. Introduction

In nuclear power plant decommissioning operations, the process of cutting radioactively contaminated metal generates radioactive aerosols. Radioactive aerosols cause radiation exposure when inhaled into the human body by breathing. Radioactive aerosol monitoring is necessary to protect workers from internal radiation exposure in the workplace. However, in the decommissioning workplace, the internal exposure evaluation of workers is uncertain due to simple measurement of radioactivity in the air. Real-time aerosol analysis is required for accurate radioactive aerosol evaluation. In this study, high-resolution aerosol database (hereinafter referred to as HRADB) design, a key component required for real time aerosol analysis software, was conducted.

## 2. Database Design

### 2.1 Entities

The basic entities consist of the database are defined as four types: Cutting object, Cutting method, Aerosol measurement, and Aerosol characteristics. In general, when decommissioning nuclear power plants (NPPs), an appropriate cutting method for the object is determined after the object is selected. The characteristics of the aerosol generated during metal cutting vary depending on the cutting object, cutting method, and cutting conditions[1,2]. Therefore, the database to support the evaluation of the characteristics of the aerosol generated in the workplace should include cutting material, cutting method, aerosol measurement and the characteristics of the aerosol linked to them.

#### 2.1.1 Cutting operation Entities

Cutting operation includes the cutting object, cutting method, and cutting conditions(Fig. 1). The cutting method is determined by the type of cutting tool and cutting conditions.

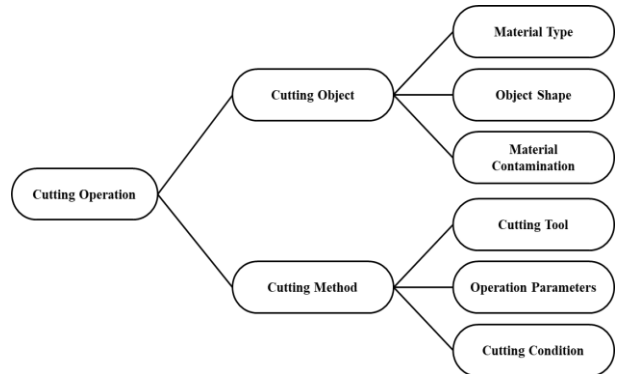


Fig. 1. Relationship between cutting operation and cutting conditions diagram

#### 2.1.2 Aerosol measurement Entities

Aerosol measurement is determined by the measurement instrument, the measurement range of the particle size, and the limitations of the particle concentration and resolution[3]. The measurement limit of the measurement instrument should be confirmed by indicating the measurement instrument model and method used to obtain aerosol characteristics. Aerosol characterization includes number concentration obtained through aerosol instrument of measurement and mass concentration and chemical composition obtained through aerosol elemental analysis(Fig. 2).

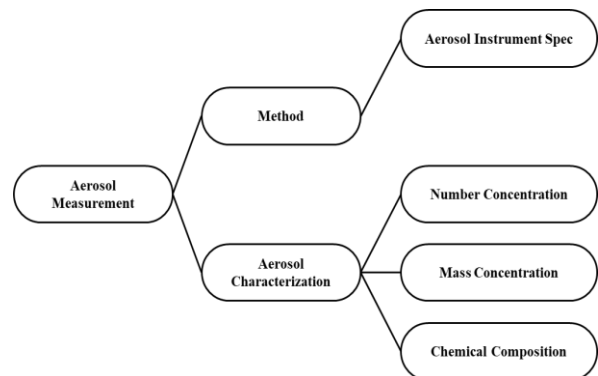


Fig. 2. Relationship between aerosol measurement and aerosol characterization diagram

## 2.2 DBMS selection

HRADB needs an open source based database management system in consideration of future scalability. Therefore, MySQL, an open DBMS(Database Management system), was selected in consideration of the usability of users using the program, the program management tool, and the Python interface.

## 2.3 Database result export

In the HRADB, it can export the results of the data. For example, it is possible to confirm the number concentration the characteristic of the aerosol generated during metal cutting (aerosol generation over time, aerosol number concentration) and the chemical composition of aerosol(Fig. 3).

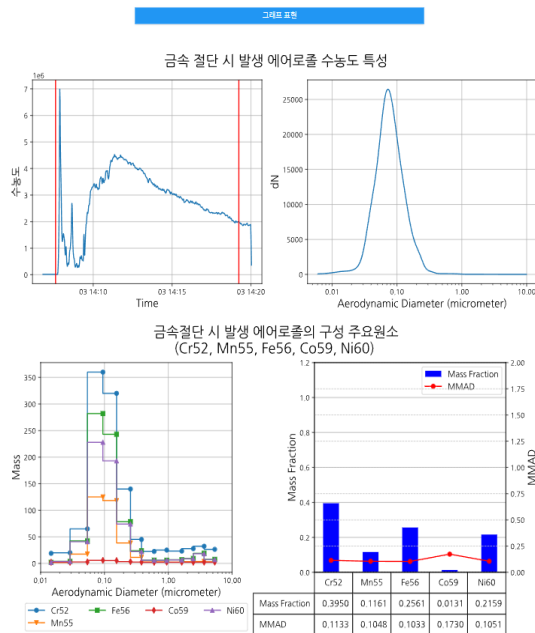


Fig. 3. Display of aerosol measurement results from HRADB

## 3. Conclusions

The HRADB is a database that collects characteristic data on aerosols generated during the cutting process of radioactive metal structures, which are the core of NPPs decommissioning. HRADB includes cutting object, cutting method, cutting tool, aerosol measurement data, and aerosol characteristic data as NPPs decommissioning. DBMS was selected as MySQL. MySQL is an open DBMS with user convenience and scalability. HRADB is currently under development, and HRADB can be used as a key component of real time aerosol analysis software.

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## REFERENCES

- [1] N. Chae, M. Lee, S. Choi, B.G. Park and J. Song, Aerodynamic diameter and radioactivity distributions of radioactive aerosols from activated metals cutting for nuclear power plant decommissioning, Journal of Hazardous Materials, Vol. 369, pp.727-745, 2019
- [2] M. Lee, W. Yang, N. Chae and S. Choi, Aerodynamic diameter distribution of aerosols from plasma arc cutting for steels at different cutting power levels, Journal of Radioanalytical and Nuclear Chemistry, Vol. 323, pp.613-624, 2020
- [3] M. Lee, W. Yang, N. Chae and S. Choi, High resolution size characterization of particulate contaminants for radioactive metal waste treatment, Nuclear Engineering and Technology, Vol. 53(7), pp.2277-2288, 2021
- [4] J. Wang, T. Hoang, E. Floyd, E. Floyd and J. L. Regens, Characterization of Particulate Fume and Oxides Emission from Stainless Steel Plasma Cutting, Annals of work exposures and health, Vol. 61(3), 2017