# System for Measuring Characteristic of Aerosol From Metal Cutting

Wonseok Yang*, Nakkyu Chae, Minho Lee, and Sungyeol Choi
Korea Advanced Institute of Science & Technology, 291, Daehak-ro, Yuseong-gu, Daejeon, Republic of Korea
*abw94@kaist.ac.kr

## 1. Introduction

In the process of dismantling nuclear facilities, radioactive materials are released in various form. To plan decommissioning nuclear power plant safely, it is important to fully understand the forms and quantities of radioactive materials.

Radioactive airborne particles are one of form of by-product which produced during the cutting radioactive materials, such as activated metal. Inhalation of radioactive aerosols can adversely affect worker's health during dismantling [1]. The aerodynamic distribution of radioactive aerosols will determine the impact of internal exposure [2]. Therefore, the size distribution of aerosols, which produced during cutting, need to be studied. This paper presents the aerosol system for the measurement of physical and chemical characteristics of aerosol from metal cutting.

## 2. The system for the measurement of characteristics of aerosol from metal cutting.

In a laboratory experiments, we use a plasma arc torch (powermax125, Hypertherm) for cutting metal. Electrical low pressure impactor (ELPI+, Dekati) is used for a measurement of aerosols.

### *2.1 Chamber and automated cutting system*

For safety of researcher, we installed the isolated aerosol chamber. The chamber size is 1.2*1*0.65[m]. There is a HEPA filter inlet for air flow. For reproducibility, it has automated cutting system. The automated cutting system is made up of x-moving stage with servo motor and a control box for plasma and x-stage movement. The control box can set the cutting start point, the cutting end point, a speed and a length of cutting.

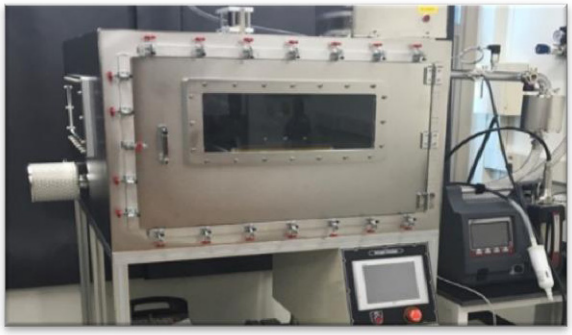

Fig. 1. The aerosol system for the measurement of physical and chemical characteristics of aerosol.

### *2.2 Sampling and measurement system*

ELPI+ measures aerodynamic diameter distribution and its concentration in real time. It measures the size range of 6 nm – 10 μm with 10 Hz sampling rate. After the measurement it is possible to collect size classified particles in 14 stages for chemical analysis. For chemical analysis we will conduct ICP-MS and SEM-EDS to know composition of aerosols and morphological characteristic. At sampling pipe, there are two sampling lines, velocity lines and pressure lines. The velocity and pressure are measured at sampling point (center of the sampling pipe).

Fig. 2. Sampling pipe and measurement lines.

## 3. Metal cutting test

*3.1 Isokinetic sampling*

To minimize distortion aerodynamic distribution during the sampling, isokinetic sampling is important. For isokinetic sampling, the velocity of air in sampling pipe and sampling port must be matched [3].

For matching the velocity of air during sampling, we measured velocity through velocity line at sampling pipe with probe thermometer (Testo110, Testo). According to the measured velocity we chose sampler head diameter (5-10 mm).

Fig. 3. Sampler with sampler head.

*3.2 Metal cutting test setting*

For test we used stainless steel plate 10mm thick. We cut metal plate with plasma arc torch (Current 75 A) with air. We set the cutting speed (10 mm/s) and cutting length (50 mm). We set the cutting speed and plasma arc torch current which can cut the metal completely. Measuring time was 30 minutes because 30 minutes after cutting, the number concentration falls off similar to background number concentration (~$10^2$ $m^{-3}$ ).

*3.3 The metal cutting result*

Fig 4 is the result of the test cut a 10 mm thick stainless-steel plate at 10 mm/s speed with plasma arc torch (current: 75 A) for 5 seconds

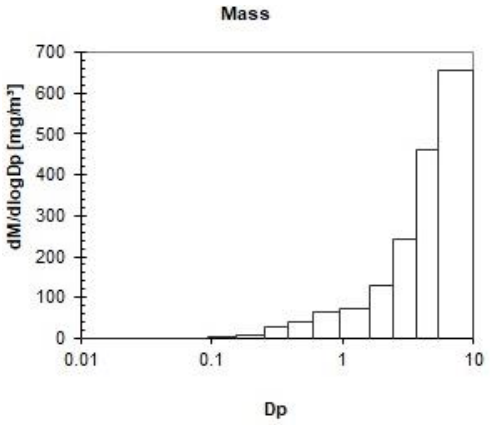


Fig. 4. The mass distribution in response to the aerodynamic distribution.

## 4. Conclusion

We set the aerosol system for measurement of physical and chemical characteristics of aerosols from metal cutting. With this system, we will experiment different power, speed and different kinds of metal that uses in nuclear power plant. The result is aerodynamic distribution of aerosols and chemical composition of each stage. With our experiment result, we expect to suggest optimum way to cutting radioactive waste to minimize internal dose of worker.

## ACKNOWLEDGEMENT

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