PA4) 다공성 금속판을 이용한 전기적 임팩터의 평가
Evaluation of an electrical impactor with porous metal substrate

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1. Introduction

One of drawbacks of the inertial impactor measurement is the required long sampling time (Keskinen *et al.*, 1992). In a gravimetric method, an impaction substrate must be weighed and placed on the corresponding collection plate before being assembled. After sampling, the inertial impactor is disassembled and the collection plate is weighted again. The sampling time depends on the sampled particle mass because the collected particle mass must be sufficiently high to be measured by a sensitive microbalance. The sensitivity of this method is also low for the smallest particles. Additionally, no information is gained on the time variation of the particle size distribution and concentration during the sampling because of the integral nature of the sample.

In this study, we used a porous metal substrate (Mott Corp., Farmington, CT) with an electrical impactor to enhance the precision of electrical detection by reducing the particles bounced from the substrate. The purpose of this study was to investigate the characteristics of a porous metal substrate in the electrical impactor and compare various porous metals with a flat plate.

2. Experimental

The collection efficiency of the electrical impactor was calibrated by the electrical method. Figure 1 shows the schematic diagram of the electrical impactor. Polystyrene latex particles (PSL; density = 1.05g/㎤) were generated using a collision atomizer (model 9302, TSI Inc.). The particle-laden stream passed through a Kr-85 neutralizer. Aerosol was drawn into the test impactor at a flow rate of 30 l/min using a mass flowmeter and controller with a vacuum pump. Aerosol was introduced into the electrical impactor as the three-way valve was controlled. As aerosol particles passed through the charger, they captured positive ions generated by corona discharge. On the collection plate and a Faraday cup, the collected particles gave rise to an electrical current that was measured by a multi-channel electrometer. A PC was used for recording the measurement results. A single-stage impactor of the K-JIST cascade impactor (Kwon *et al.*, 2002), which consists of a nozzle plate with 40 circular holes (jet diameter = 0.58mm), and interchangeable collection substrate

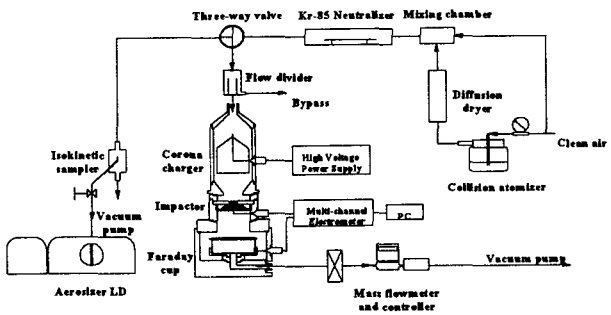

Fig. 1. Real-time measurement setup for single-stage impactor.

of a porous metal or a flat plate, was used. This stage was designed as a cutoff diameter of 0.7㎛. The pore sizes of 0.2, 10, 20 and 40㎛ with a thickness of 0.99, 1.57, 1.57 and 1.98㎜ were tested, respectively. The electrical method was also compared with the particle counting method, which was employed to get the particle collection efficiency by counting the number concentration of particles with and without the collection plate in the downstream of stage, at the same condition.

3. Results and Discussion

Figure 2 shows current signals of electrical impactor with the porous metal with pore size of 0.2, 10, 20 and 40㎛ and a copper substrate. Solid PSL particles were introduced for 1 minute while a high positive voltage of 6kV was supplied to corona charger. The current signal increases as the pore size increases because of the excess particle collection of the porous metal (Heikkinen and Harley, 2000). The current signal of an electrical impactor with a copper substrate is also lower than that with a porous metal. Figure 3 shows the collection efficiency obtained from the electrical impactor compared with that obtained by counting the number concentrations. The collection efficiency calibrated by electrical method was defined as the ratio of current measured from the collection plate to the sum of currents measured from the collection plate and the Faraday cup. It was found that the collection efficiency calibrated by electrical method almost agrees with that by particle counting method.

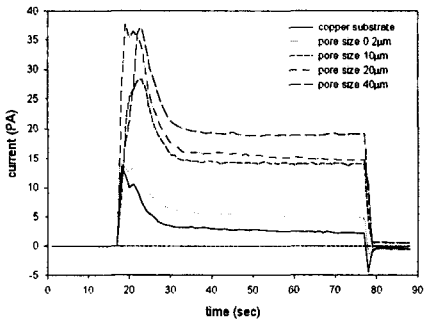

Fig. 2. Strip chart records of the output from the collection plate (PSL size = 2.07㎛).

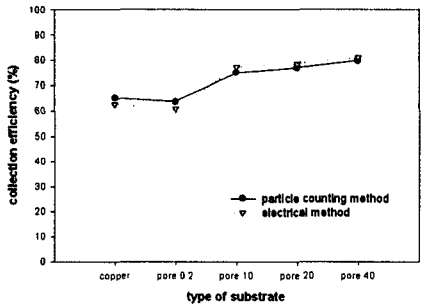

Fig. 3. Comparison of collection efficiencies calibrated by electrical and particle counting method.

Acknowledgement

This work was supported by the National Research Laboratory (NRL) program of the Korea Institute of Science and Technology Evaluation and Planning (KISTEP).

References

Heikkinen, M. S. A. and Harley, N. H., (2000) Experimental Investigation of Sintered Porous Metal Filters, *J. Aerosol Sci.*, **31**, 721-738.

Keskinen, J., Pietarinen, K. and Lehtimäki, M. (1992) Electrical low pressure impactor. *Journal of Aerosol Science*, **23**, 353-360.

Kwon, S. B., Lim, K. S., Jung, J. S., Bae, G. N. and Lee, K. W. (2002) Design and calibration of a 5-stage cascade impactor (K-JIST cascade impactor). submitted to *Journal of Aerosol Science*.