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DA4) 단분산 입자와 다분산 입자를 이용한 싸이클론 및 임팩터의 성능평가

Performace of a Cyclone and an impactor Using Monodisperse and Polydisperse Particles

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1. INTRODUCTION

Monodisperse aerosols containing spherical particles of known size, shape and density are the most widely used to calibrate particle-size measuring instruments and to determine the effects of particle size on the sampling device. However, these tests are time-consuming because monodisperse aerosols with different particle sizes are generated and tested in a series of experiments. Polydisperse aerosols may be used to determine the calibration or to simulate equipment under controlled laboratory condition. Rapid measurement of entire sampling efficiency curves of instruments can be facilitated by a single experiment with a polydisperse aerosol. Measurement systems for the testing of a sampler, which use polydisperse particles, have been described by some researchers (Baron, 1983; Kenny et al., 1991).

In this study, polydisperse particles were prepared by mixing several monodisperse particles with different sizes. A cyclone and an impactor were used to evaluate and compare collection efficiencies using monodisperse and polydisperse particles.

2. EXPERIMENT

An atomizer was used to generate the test aerosols. Air laden with particles was passed through diffusion dryer at a flow rate of 5 L/min, and mixed with clean air in a dilution chamber. The particle-laden air, drawn using a vacuum, was passed though a cyclone at 40 L/min and 80 L/min and an impactor at 30 L/min. An isokinetic sampling tube was used for aerosol sampling, and the measuring points were positioned at the cyclone (or impactor) inlet and outlet. Aerosizer LD (API Inc.) was used to detect particles with diameters of 0.5 to 10 μm.

Monodisperse polydisperse latex (PSL) particles with 0.5, 0.99, 2.04, 2.92, and 4.5 m were generated respectively and polydisperse particles were generated after mixing these monodisperse particles in a container.

3. RESULTS AND DISCUSSION

The diameters of the monodisperse particles used were 0.5, 0.99, 2.04, 2.92, and 4.5 m, as specified by the manufacture. In present work, the geometric mean diameters of the generated monodisperse particles were measured as 0.51, 0.98, 1.87, 2.75, and 4.3 m and associated geometric standard deviations were 1.15, 1.10, 1.13, 1.13 and 1.2 respectively. The size distribution of the polydisperse particles generated had multimodal peaks as shown in Figures 1 and 2. Each peak had the same peak position and with the same shape, as can be seen in the size distribution of monodisperse particles. This is because few differently-sized particles generated from mixed monodisperse particles are produced by aggregation or coagulation. Results show that the collection efficiency curve of the cyclone and the impactor using polydisperse particles generated by mixing several monodisperse particles of known size is in accord with the results of the same test conducted on monodisperse particles as shown in Figures 3 and 4. These results mean that these polydisperse particles can be used for evaluating the performance of other cyclones and impactors.

It is possible to measure the entire collection efficiency of a sampler rapidly in a single experiment with a polydisperse aerosol instead of performing a series of experiments using monodisperse aerosol. Moreover, the size distribution of polydisperse particles can be controlled easily by mixing monodisperse particles of a known size.

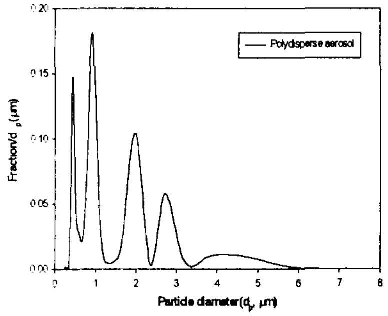

Fig. 1. Size distribution of generated polydisperse PSL particles.

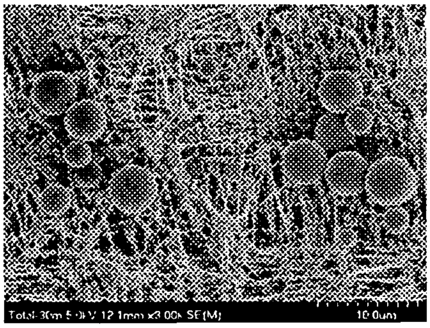

Figure 2. Scanning electron photomicrograph of generated polydisperse PSL particles

(a) 80 L/min

(b) 40 L/min

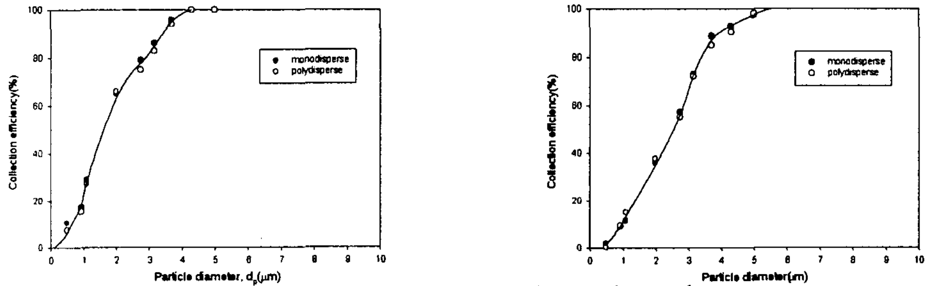

Fig. 3. Particle collection efficiency of a cyclone

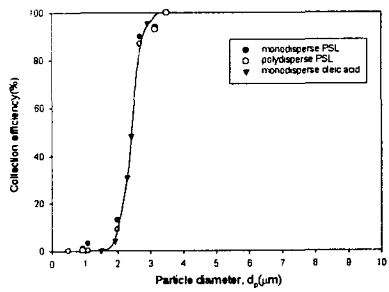

Fig. 4. Particle collection efficiency of an impactor

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