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PA13) Characterization of Particle Losses in a Perma Pure Dryer

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1. INTRODUCTION

Particle - bound water changes the physical and chemical properties of aerosol particles, such as size and light scattering properties. Consequently, it is necessary to remove water vapor from ambient aerosols before aerosol particles are sized and counted. Silicon gel diffusion dryer is commonly employed for this purpose. However, it can not be operated continuously. While in operation, silicon gel becomes progressively more loaded with water and must periodically be regenerated by drying off the water. Recently, Perma Pure dryer has been used to remove water from the humid ambient aerosol (Day et al., 2000 and Meyer et al., 2000). However, little information is available on the particle losses occurring in the Perma Pure dryer during operation. Therefore, experiment was conducted in this study to examine the particle losses in the Perma Pure dryer.

2. EXPERIMENT

Particle losses test was conducted with particle ranging from 0.913 um to 2.92 um in size. Particles were generated with an atomizer (TSI Inc., Model 9302). The solution used in the atomizer consisted of the PSL particle mixed with de-ionized water. Before being put into the atomizer, the solution was dispersed for 15 minutes with ultrasonic bath. After the particle generation, a silica gel diffusion dryer was used to remove the water from the particle-laden gas. Consequently, the aerosol was introduced into the Kr-85 neutralizer to bring them to a state of charge equilibrium. Then the particles were diluted in a small dilution chamber with filtered air using a HEPA filter. Finally, the aerosol was passed through the Perma Pure dryer. At flow rate of 5lpm up to 40lpm, which is the maximum flow rate for PD-200T-24SS model, up- and down- stream aerosol concentrations were measured with aerosizer alternatively. To reduce errors from possible time variations in the upstream aerosol concentrations, measurements were repeated at least 10 times for each combination of particle size and flow rate.

3. RESULTS AND DISCUSSION

Penetration efficiency of particles is plotted against particle size in microns as shown in Figure 1. Obviously, when the flow rate is low, particle loss is negligible for all the particle sizes tested in this experiment. As flow rate increases from 5 L/min to 40 L/min, the particle penetration is reduced, especially for particles larger than 1 m. However, no general trend can be observed for the variation of penetration with particle size. For particles smaller than 1 m, particle loss is insignificant at all flow rates. Particle penetration is observed to dip at 1.53 m, probably because both inertial and diffusional losses are significant for this particle size. With the exception of particle of 1.53 m, the decrease of penetration efficiency with particle size appears to be monotonic at flow rates higher than 10 L/min, indicating that inertial loss is the dominant loss mechanism at high flow rate.

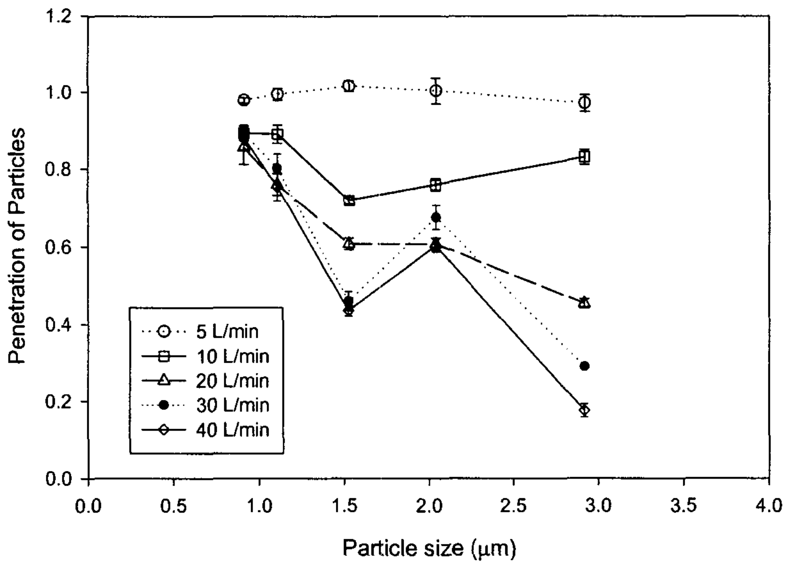

Figure 1. Penetration efficiency as a function of particle size

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