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PC1) 섬유질 필터내의 다분산 에어로졸 입자의 확산 침착에 관한 해석적 해

Analytic Solutions to Diffusional Deposition of Polydisperse Aerosols in Fibrous Filters

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INTRODUCTION

Deposition of polydisperse aerosols by Brownian diffusion was studied analytically using the penetration efficiency of monodisperse aerosols combined with the correlations among the moments of lognormal distribution functions. The analytic solutions so obtained were validated using the exact solution were applied to recalculate the filtration efficiencies of the existing experimental data for various filtration conditions. It was found that the collection efficiency of a fibrous filter should be corrected with respect to the position in the filter, if particles are polydisperse. By considering the effect of the polydispersity of particle size, the analytic solutions showed good agreement with existing experimental data. It is believed that the present works make it possible to determine the filtration efficiency of polydisperse aerosols in fibrous filters and estimate errors associated with the degree of polydispersity of the particles quickly and accurately for diffusion dominant regime.

ANALYTIC SOLUTIONS

Analytic solutions for predicting the filtration efficiency of polydisperse aerosols in fibrous filters were derived using the approximation of slip correction factor and the correlations among the moments of lognormal function. The derived filtration efficiency solutions were validated by the exact solution.

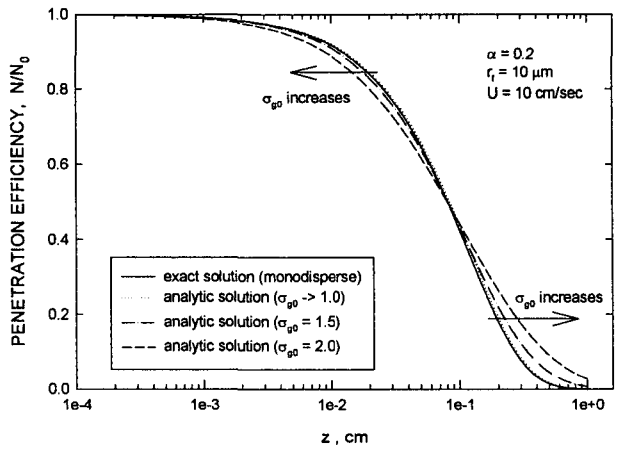

Fig. 1. Comparison of exact solution and analytic solutions.

It was found that the analytic solution in the case of the monodisperse particle was accurately matched with the exact solution according to the filtration position. However, when the polydispersity of the particles was considered, deviation from the exact solution was noted. The penetration efficiency of polydisperse particles decreased faster than that of the monodisperse particles in the early stage of filtration, but this occurred at a lower rate as filtration proceeded. Therefore, the filtration efficiency, if monodispersity of particle size is assumed, should be corrected by the effect of polydispersity according to the position in the filter. Finally, the analytic solutions were compared with experimental data (Lee and Liu 1982), and it was found that the variation of experimental efficiency with respect to size and the variation of experimental efficiency with respect to solidity were both predicted with satisfactory accuracy by analytic solutions at different filtration velocities. It is believed that the present works make it possible to determine the filtration efficiency of polydisperse aerosols in fibrous filters and estimate errors associated with the degree of polydispersity of the particles quickly and accurately for diffusion dominant regime.

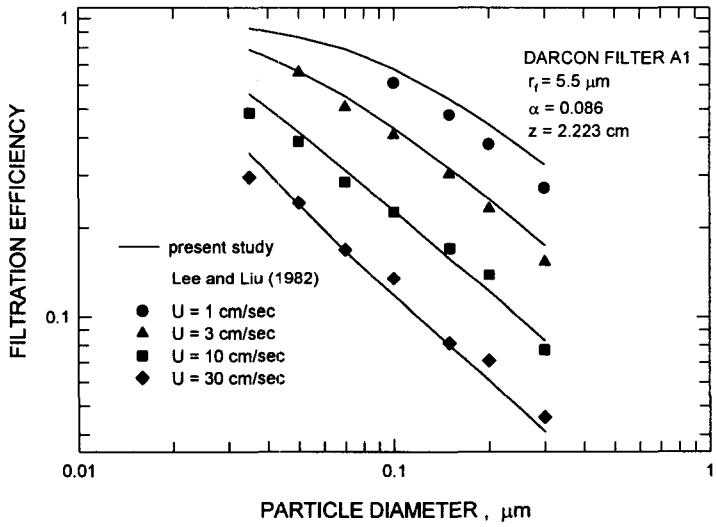

Fig. 2. Comparison between experimental results and analytic solutions for the filtration efficiency of the Dacron A1 filter.

ACKNOWLEDGEMENT

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REFERENCE

Lee, K. W. and B. Y. H. Liu (1982) Aerosol Sci. and Technol., 1:35-46.