CHAPTER 2

SCOPE AND OBJECTIVES

The majority of natural and artificial produced aerosols possess considerable polydispersity in particle size. Past investigations, especially theoretical ones, on aerosol filtration generally used a certain mean size or monodisperse aerosol to represent an aerodisperse system. Such monodisperse representation is, in view of the strong dependence of physical properties of aerosols on particle size, seldom sufficient for the characterization of an aerodisperse system. Therefore studies on the effects of polydispersity on aerosol behavior are important. This work deals with the convective diffusional deposition of polydisperse aerosols on a representative fiber with dust loads. Their size distributions are geverned by a log-normal distribution.

The main objectives of this study are :

(1) To modify and extend a three-dimensional stochastic model for convective diffusionsl deposition of monodisperse aerosols on a dust loaded fiber, which was developed by Kanoaka et al. (1981), to include polydisperse aerosols.

(2) To investigate the collection efficiency of a single cylindrical fiber for the case in which the main transport mechanism of aerosol particles is convective Brownian diffusion.

(3) To compare the results obtained for convective diffusional deposition of polydisperse aerosols, on a single fiber with those obtained by Kanoaka et al. (1981) for the case of monodisperse aerosols, in order to reveal the effect of polydispersity.

(4) To elucidate the principal phenomena of aerosol filtration by fibrous air filter.

To accomplish the above goals, this study encompassed the following tasks :

(1) Modification of the previous stochastic model to include the case of polydisperse aerosols.

(2) Selection of appropriate parametric values such as the Peclet number, interception parameter, fiber length, and geometric standard deviation of particle size distribution, etc.

(3) Stochastic (or Monte Carlo) simulation of convective diffusional deposition of polydisperse aerosol on a single fiber under various filtration conditions selected above.

(4) Statistical analysis of the simulation results obtained in (3) to reveal the characteristics of convective diffusional deposition of polydisperse aerosols.