

# FILTRATION CHARACTERISTICS OF THE ACTIVATED CARBON/CHARGED FIBER HYBRID FILTER

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## INTRODUCTION

Activated carbon is the commonly used solid adsorbent for continuous sampling of gaseous hazards in the environment. In recent years, activated carbon has been also applied in the indoor air cleaners to remove the gaseous pollutants. For convenient use in the air cleaning devices, activated carbon is produced as the activated carbon fiber (ACF) filter. The activated carbon/charged fiber hybrid filter has become a popular indoor air-cleaning device. The charged filter layer is used to collect indoor aerosol, and the activated carbon layer is primarily used to remove gaseous pollutants. In addition gaseous pollutants, the ACF layer is also a kind mechanical filter that can be used to collect aerosols. However, very few researchers have investigated the aerosol filtration characteristics of the ACF layer of the manufactured hybrid filter. Therefore the objectives of the present study are (1) to investigate the aerosol collection efficiency of ACF and charged filter layers of the hybrid filter and (2) to understand the principal filtration mechanisms of the hybrid filter.

## EXPERIMENTAL METHODS

Two type activated carbon/charged fiber filters, type A and type B, were used in this study. The test aerosol was generated in polydisperse state by a Collison atomizer. Then the dried and neutralized polydisperse aerosol was classified electrically by a Differential Mobility Analyzer (DMA) to get the monodisperse singly charged aerosol in the submicrometer-sized range of 0.05 to 0.5  $\mu\text{m}$ . The aerosol from the DMA was passed through a Kr-85 radioactive source, which neutralized the aerosol to the Boltzmann charge equilibrium (neutral aerosol). Sodium chloride (NaCl) and di-2-ethylhexyl-sebacate (DEHS) were chosen as the solid and liquid test agents, respectively. The aerosol penetration of the tested filters was measured by two condensation aerosol counters (CPCs), which were used to measure the aerosol concentrations upstream and downstream of the filter. The face velocity through the filter was controlled by a flow meter and pump.

## RESULTS AND DISCUSSION

Figure 1a-b show that the aerosol penetration of each layer as function of aerosol size for two types hybrid filter when tested against NaCl aerosols at face velocity of 10 cm/s. The results indicate that the aerosol penetrations for the ACF of two type hybrid filters are in the range of 88% to 95%, which are much lower than that of the charged fiber layer of two type hybrid filters. The main filtration mechanisms of the charged fiber challenged with submicronmeter-size aerosols are electrostatic capture force and diffusion (Chen and Huang, 1998), but major filtration mechanism of the ACF is diffusion. This is because the challenged aerosol is submicronmeter-size aerosols and fiber diameters of the ACF layers are very large that causes diffusion mechanism to be more significant than interception. Figure 1b also shows that the aerosol penetration of the first charged fiber layer is higher than third charged fiber layer. That is because

the thickness of first charged fiber layer (0.2 mm) is smaller than third charged fiber layer (0.9 mm). Figure 2a-b show that the aerosol penetrations of NaCl and DEHS aerosols for two types hybrid filter versus aerosol size for face velocity of 10 cm/s. The experimental results show that these two hybrid filters have lower aerosol penetration for NaCl solid aerosol than DEHS liquid aerosol. That is similar to the results of electret filter by Martin and Moyer (2000). This indicates that the charged fiber layer of the activated carbon/charged fiber filter contributes the major aerosol-collection.

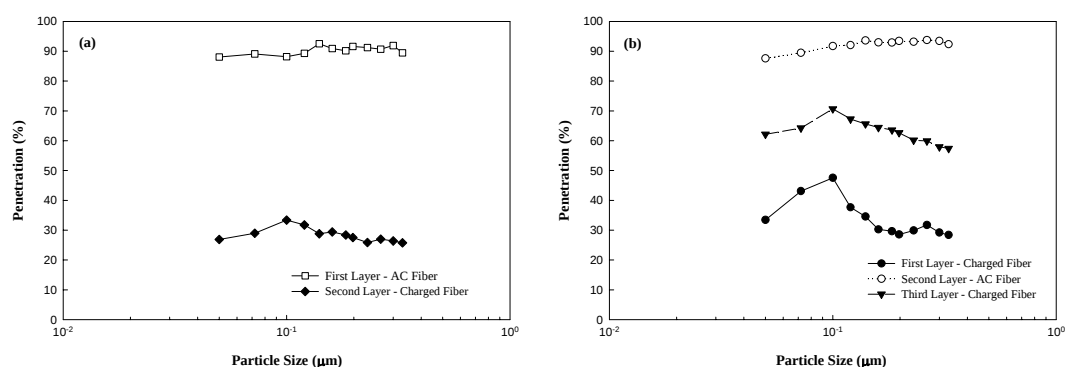


Figure 1. Aerosol penetration of the activated carbon/charged fiber hybrid filter challenged with NaCl aerosols at face velocity of 10 cm/s. (1a. type A hybrid filter; 1b type B hybrid filter)

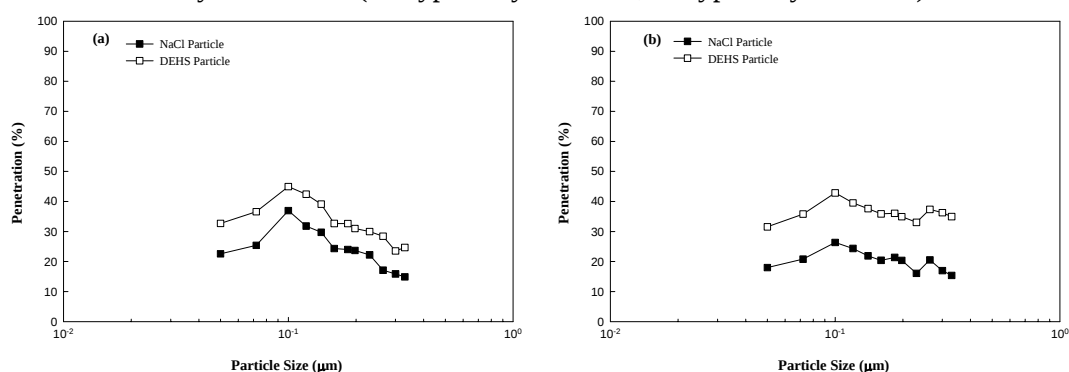


Figure 2. Aerosol penetration of NaCl and DEHS aerosols versus aerosol size for face velocity of 10 cm/s. 2a. type A hybrid filter; 2b. type B hybrid filter.

## CONCLUSIONS

The experimental results show that the ACF layer has very higher aerosol penetration and the main filtration mechanism is diffusion. The aerosol collected by the charged fiber layer contributes the mainly aerosol collection of activated carbon/charged fiber filter.

## ACKNOWLEDGEMENTS

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