

A study on exposure levels to aerosol particles during the journey of a subway passenger

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Particulate matter (PM) penetrated deep into the lungs according to their size has a high alveolar deposition rate. In particular, fine particles become factors degrading lung function of the human body and increasing the occurrence of lung cancer. The purpose of this study is to understand the characteristics of particle sizes inhaled by a passenger depending on the location of subway passengers. We measured the size distribution of aerosol particles following the journey route of the subway as outdoor (A), concourse (B), platform (C) and inside train (D).

This study was performed at two major transfer stations of Seoul in 2015. The first measurement was conducted in jongno 3-ga station on October 7-8. The second measurement were executed at City Hall station in the same way. The PM number concentration was measured by Optical Particle Sizer (TSI, Model 3330). An investigator carried a lightweight portable backpack loaded an OPS and it set up to collect the size distribution data every 5 second. The total measurement time was approximately 40 minutes for one journey.

As shown in Fig 1(a), the number concentration of submicron particles (0.3-0.5 μm) was the highest in outdoor (A). The number concentration decreased as approaching to the station inside (B, B'), whereas it increased abruptly when passenger boarded on the train (D). The value of inside trains (D) was higher than in the concourse (B) and platform (C, C').

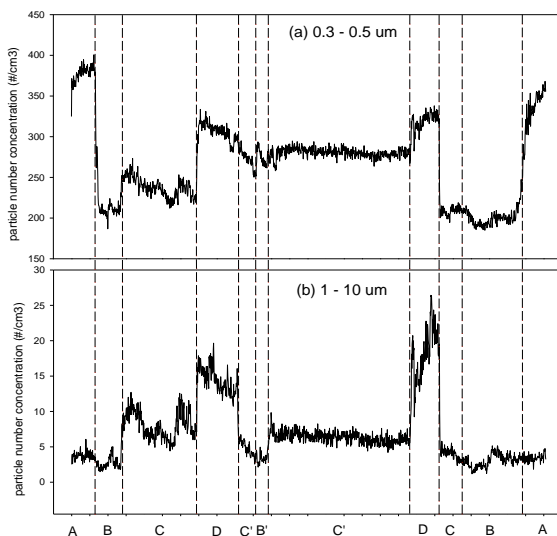


Figure 1. Change of particle number concentration during the journey of passengers for particle sizes of (a) 0.3-0.5 μm and (b) 1- 10 μm

In case of the larger particles (1-10 μm), number concentration of outdoor and concourse (A, B, B') showed the lowest level. It increased sharply in the platform (C) and showed the highest value in a train (D) as shown in Fig 1(b).

We estimated the exposure level to different sized particles during the journey time. To calculate the exposure value based on inhalation rate, the average air breathing rate of an adult presented by Rick and Graham (1999) was used (walking: 14L/min, standing: 7.5 L/min). A passenger takes the highest number of submicron particles in the outdoor during the walk. On the other hand, a passenger takes the highest number of larger particles in the inside train during the transport (Table 1).

Table 1. Inhalation rates of particles per minute at 4 journey locations.

Point	Main activity	Inhalation rate of particles (#/min)		
		0.3-0.5 μm	1-10 μm	
A	Outdoor	Walking	4,257,544	54,069
B	Concourse	Walking	2,989,338	41,734
C	Platform	Standing	1,538,794	39,900
D	Inside train	Standing	1,821,398	87,106

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Rick, B., Graham, B. (1999) Criteria For The Design Of Emergency Refuge Stations For An Underground Metal Mine, Journal of the AusIMM. p.1-12