Characterization of particular matters in subway HAVC system

S. Huang and Y.M. Jo

Department of Environmental engineering, Hyunghee University, Yonggin-si, Geyonggi-do, 446701, South Korea
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Presenting author email: coral-119@163.com

Underground subway microenvironments have been a great concern as metro is an important public transportation in metropolis. Subway aerosol particles, which are generated mainly by the movement of trains and passengers, and accumulated in a closed environment (Jung *et al*, 2012), resulted in high concentrations of indoor particular matter (PM). Particles of less than 25μm are known to be dominant size distribution of inhalable particles. They are responsible for atmospheric environment and human health effects. Usually, HVAC systems are applied to refresh the underground subway system with filtration.

To achieve better underground subway air quality, this article is devoted to analyzing the air quality in subway HVAC system, characterizing the properties of PM. Since there is no any investigation on magnetic performance of particle aggregation, the magnetic agglomeration of inhalable particles in the external magnetic field prior to filtration by CFD and experiment will be suggested and carried out in further study, serves as a tool for the design of environmental control systems indoor.

Particle samples used in this study were collected from the eletret filter in subway HVAC system (Taechong station, Jeki station). The magnetic fraction was separated by a magnet of 5000 Oe which wrapped with a weighing paper. Herein, the magnetic particles were defined as those attracted to the magnet.

X-ray diffraction (XRD) patterns of magnetic particles were obtained by D8 Advance (Bruker) using Cu Kα radiation. The 2θ scanning range was 10-100^o with an increment of 0.02^o (2θ), scanning speed was 3 ^{o}/min. Mineral identification was based on reference JCPDS card.

The morphology was observed by a scanning electron microscope (SEM, Stereoscan 440) with an energy dispersive X-ray detector (EDX, Oxford 7060) for chemical analyses. Measurement of particle size distributions was carried out by Malvern with MSS0010 model working in a light scattering regime.

Results turned out that all of particles collected in subway HVAC system were magnetic, indicating that the sources of them were present near the rails. It alarms public the close relationship between the atmospheric and indoor air quality. Figure 2 showed that the size of sampling particles were in the range of 0.01-200μm, and the average size was 22 μm while the 90% size were below 65μm. XRD patterns and SEM/EDX spectrums demonstrated that Fe_2O_3 (its strongest peak is at 33.9^o 2θ) and Fe_3O_4 (its strongest peak is at 35.5^o 2θ) (see Figure 1) existence. Most of the particles were Fe-containing particles mixed with Ti, Si, Ca, S and C, as shown in Figure 3. These results were agreed with Kukier's (2003) which stated that magnetic fractions contained magnetite, hematite and also quartz. Due to the magnetic properties of particles, external magnetic field will be applied to study the agglomeration of particles in subway HAVC system prior to filtration in following paper.

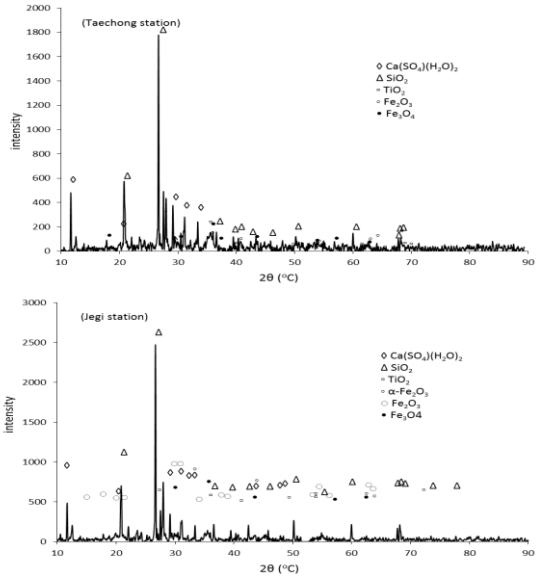

Figure 1. XRD patterns of Taechong and Jegi samples.

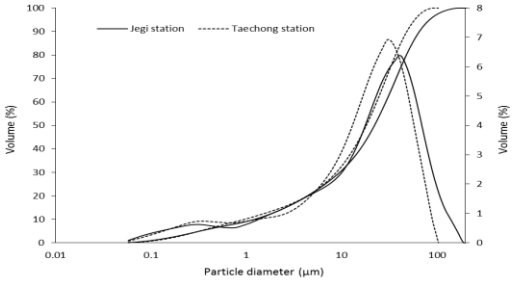

Figure 2. Size distribution of subway samples

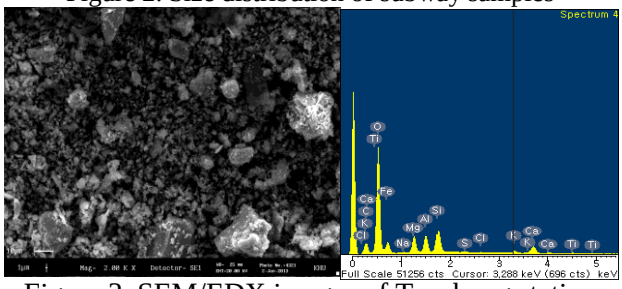

Figure 3. SEM/EDX images of Taechong station

Hae-Jin Jung, et al (2012) *Journal of hazardous materials* **213-214**, 331-340.

Urszula Kukier, et al (2003) *Environmental pollution* **123**, 255-266.