

January 21, 2019

Keio University

**Investigation of Particulate Matter within
Subway Station Environments Published**
—Decision to Convene Symposium to Consider Subway Environments—

As the first stage of an industry-academia collaboration project aiming to facilitate “subways with the world’s cleanest air,” MANN+HUMMEL Japan Ltd. (M+H) and Keio University Faculty of Science and Technology published field study results covering PM_{2.5} particulate matter inside a subway station. According to these results, the concentration of PM_{2.5} in the subway platform air reached a maximum of about 5 times higher than that of aboveground levels. The concentration of iron contained in the particles when compared with those aboveground in particular was extremely high, at over 200 times the aboveground levels. The outcomes of this research were published in the January 10 (Thurs.), 2019 issue of the academic journal “Journal of Japan Society for Atmospheric Environment.”

Furthermore, based on the results of this study, the Keio University Faculty of Science and Technology has decided to hold a symposium to consider subway environments in cooperation with the Japan Association of Aerosol Science and Technology on May 18 (Sat.), 2019 at Keio University Hiyoshi Campus.

1. Background

The subway is an extremely important part of the transportation infrastructure in urban areas of Japan, and is an essential component of the livelihoods of many people. However, despite the fact that subway systems are closed spaces and there are concerns about the contamination status of the air within, no systematic investigations on the actual status of subway air quality had been carried out to date. Based on this background, Associate Professor Tomoaki Okuda of the Keio University Faculty of Science and Technology and MANN+HUMMEL Japan Ltd. (M+H; managing director: Motoi Fujiwara), with its head office located in Yokohama, have begun to take steps to facilitate “subways with the world’s cleanest air” with Yokohama Industrial Development Corporation (IDEC Yokohama) as an intermediary. This industry-academia collaborative project, which has been adopted as a designated research project by the Keio Leading-edge Laboratory of Science and Technology (KLL), aims to develop new technologies that will remove dust generated by subway carriages, brakes, and other means, by combining Keio University’s expertise on electrostatic charging of brake dust with the filtration technologies possessed by M+H. As the first stage of this project, in July 2018, field studies were carried out to analyze the behavior of particulate matter

(PM) within subway systems, including PM_{2.5}, and the results of the studies were recently summarized.

2. Summary of results

The survey was conducted from 5:00 to 20:00 on a weekday in July 2018 inside a subway station in the City of Yokohama. The survey content covered 12 items such as the concentrations of particulate matters, including PM_{2.5}, and their chemical compositions and particle size distributions (mass concentration by particle size), with 15 types of chemical components including iron and copper detected.

As a result, the concentration of PM_{2.5} within the subway system began to gradually increase from the arrival of the first train and peaked after 7:00 to 9:00 when the number of arrivals was highest (fig. 1). The PM_{2.5} concentration within the subway system was at maximum 5 times greater when compared with outdoor levels at the same times. The PM_{2.5} concentration gradually decreased afterward and remained at a constant concentration range while repeating a steady increase and decrease in the afternoon. From the chemical component analysis, it was found that the iron concentration in PM_{2.5} within the subway system was extremely high, at about 230 times greater than that of outdoor levels (fig. 2). Similarly, metals such as titanium, manganese, copper, and zinc within the subway system also showed concentrations that were several tens to over a hundred times greater than those of outdoor measurement locations. Particles generated through friction between the wheels and the rail and brakes are thought to be the major cause of this.

The outcomes of this research were published in the January 10 (Thurs.), 2019 issue of the academic journal “Journal of Japan Society for Atmospheric Environment.”

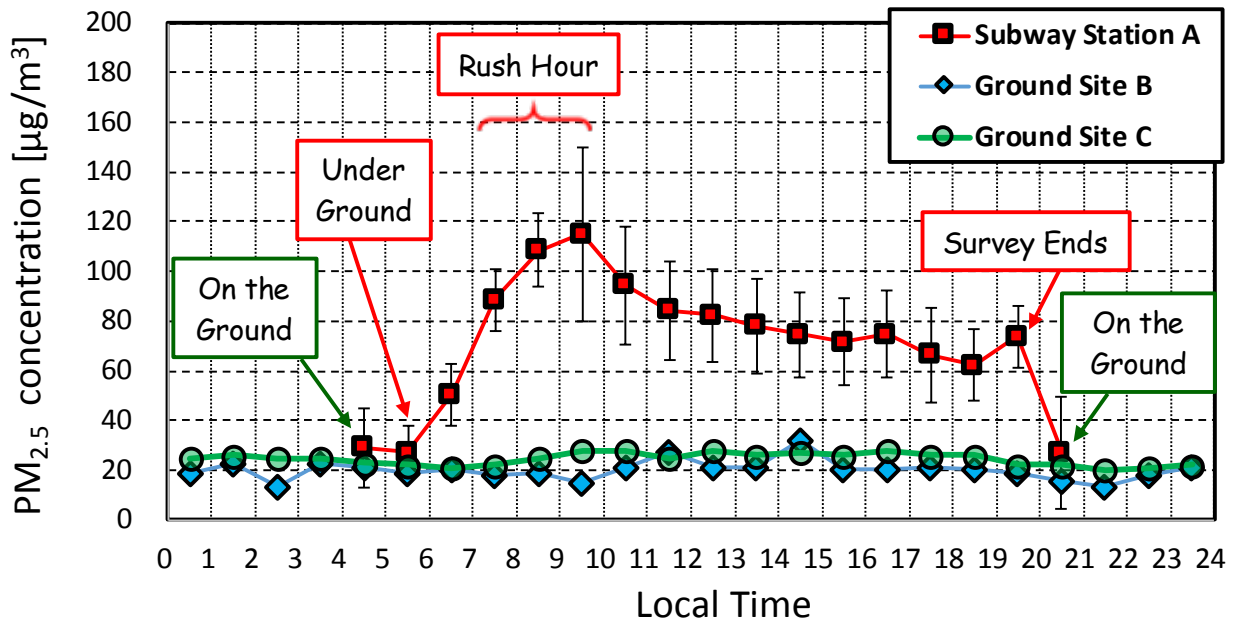


Figure 1: Variation of PM_{2.5} mass concentrations monitored in a subway station and two ground sites

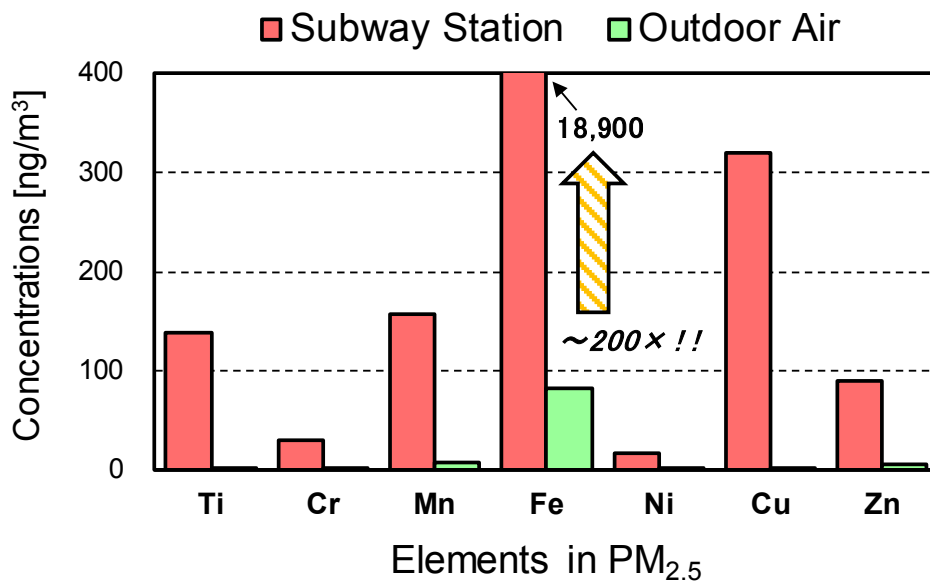


Figure 2: Element concentrations in PM_{2.5} observed at outside and subway station

3. Future developments of the project and overview of the symposium

The future goal of this project is to realize a comfortable environment for metropolitan transportation through the understanding of the air quality within subway systems, a mainstream metropolitan living space, and the leveraging of innovative technologies to remove particle matter. In addition to making direct contributions to subway users, by establishing “the world’s cleanest air” as a byword for transportation systems, an increase in branding power, not only for the City of Yokohama but Japan as a whole, can be anticipated, with a view to overseas expansion. Based on the results of this study, there are plans to take real-time PM measurements using IoT in the second stage of this project, while a demonstration experiment of a PM removal technology is planned for the third.

Furthermore, the Keio University Faculty of Science and Technology has decided in conjunction with the Japan Association of Aerosol Science and Technology to hold a symposium to consider subway environments on May 18 (Sat.), 2019 at the Fujiwara Hiroshi Hall in the Collaboration Complex on Keio University Hiyoshi Campus (time TBD). In addition to presentations on the findings of this study, lectures by experts on environment-related railway technology and particulate matter are planned for this symposium.

4. Paper

Title: Investigation on the characteristics of particulate matter suspended in a subway station platform

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