Topic B9: Control of indoor environment

Reduction in $PM_{2.5}$ Levels at the International School of Beijing Due to Positive Building Pressurization and HEPA (H-14) Air Filtration Upgrades

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INTRODUCTION: $PM_{2.5}$, or particulate matter smaller than 2.5 μm in diameter, is a major air pollutant in Beijing, China. While recent attention has been focused on outdoor $PM_{2.5}$ levels, many people spend much of their time indoors in the city and indoor air quality in Beijing is largely unstudied. Indoor air quality at the International School of Beijing (ISB) was negatively affected by a lack of proper building pressurization and inadequate air filtration. This resulted in excessively high indoor $PM_{2.5}$ concentrations in the school during times of poor outdoor air quality. This study investigated the impact of recent upgrades to the air handling system at ISB on indoor concentrations of $PM_{2.5}$. Part of ISB's air handling system was upgraded during June and July of 2013 to create positive building pressurization and improved fresh air filtration.

METHODS: Two TSI DUSTTRAK II Aerosol Monitors (models 8530 and 8532) were used to measure $PM_{2.5}$ concentration during two monitoring periods. Monitoring occurred before the implementation of the upgrades (during 17 days in Feb/Mar 2013) and after implementation (during 24 days in July/Aug 2013). $PM_{2.5}$ concentrations were measured in 24 indoor locations, such as classrooms and offices, and compared to outdoor readings at three daily collection times.

RESULTS: The average indoor $PM_{2.5}$ concentration before implementation of the upgrades was found to be 18.2 $\mu g/m^3$, while the average $PM_{2.5}$ concentrations outdoors during the same period was 96.4 $\mu g/m^3$, which is equivalent to an 81% reduction. The average $PM_{2.5}$ concentration of indoor air after the implementation of the upgrades was 5.2 $\mu g/m^3$, while the average $PM_{2.5}$ concentration of outdoor air during the same period was 111.5 $\mu g/m^3$, which is equivalent to a 95% reduction. Fluctuations in indoor $PM_{2.5}$ concentrations were significantly reduced after the upgrades and maintained an average indoor $PM_{2.5}$ level of below 12 $\mu g/m^3$ even though outdoor $PM_{2.5}$ values fluctuated between 4 $\mu g/m^3$ and 505 $\mu g/m^3$. Indoor monitoring sites that were specifically targeted by the upgrades showed even greater reductions in $PM_{2.5}$ concentrations.

CONCLUSIONS: This study supports the effectiveness of air management upgrades at ISB to address the issues of negative building pressurization, inadequate air filtration and high outdoor pollution. Therefore, schools in highly polluted cities can safeguard the health of students and staff through targeted air management improvements. This study found that high school students could be trained to effectively conduct such studies.