Effect of Anti-idling Campaign on the Outdoor and Indoor Aerosol Exposure at Schools

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Exposure to traffic aerosols, including diesel exhaust particles, may be elevated at schools, partially because of the emission from cars and buses transporting students daily. Idling of vehicles in the school proximity may increase the outdoor aerosol concentration of fine particulate matter (PM2.5) as well as the concentrations of its constituents, including traffic-related elements. We hypothesize that an anti-idling campaign implemented at schools reduces the children exposure outdoors and indoors.

The objective of this study was to evaluate the impact of an anti-idling campaign on outdoor and indoor air quality at four urban schools in Cincinnati (Ohio, USA) with varying exposure to the school bus emission. Table 1 presents some of the characteristics of the selected schools. At each school, Harvard-type PM2.5 impactors (Air Diagnostics and Engineering, Inc. Harrison, ME, USA) operated in parallel – two indoors and two outdoors; in each pair, one was equipped with Teflon filter and one with quartz filter. The PM2.5 mass concentration was determined using gravimetric technique; the mass concentration of ten elements (Si, S, Ti, V, Mn, Fe, Cu, Zn, Br, Pb) was obtained using X-ray fluorescence analysis on Teflon filters. The quartz filter samples were analyzed for elemental and organic carbon (EC and OC) with thermal-optical transmittance.

Table 1. Characteristics of school A - D.

School	Average number of school buses operating	Average number of cars dropping-off students	Distance from highway (m)
A	5	18	303
B	39	77	526
C	11	27	243
D*	9	24	2,083

* A metro-bus stop is in the proximity

The outdoor concentrations of PM2.5 decreased at school B and D following the anti-idling campaign; no significant changes in PM2.5 were identified at school A and C. Some elemental constituents of PM2.5 decreased at all schools after the campaign was implemented; however, this decrease was mostly insignificant, except for school B, which had the greatest number of school buses and cars. For this school, we identified a statistically significant reduction of organic carbon as well as Si, Fe, and Zn. Furthermore, the levels of all traffic-related elements in the outdoor environment of school B measured before the anti-idling campaign exceeded the corresponding area levels (measured as a surrogate for the school B's community). The latter finding suggests that traffic emission was the dominant air pollution source at school B. In contrast to school B, the anti-idling campaign did not have a definitive effect on the outdoor elemental concentrations determined at other three schools. Most of the results seem to have been influenced by the time variability of the background aerosol, which represents a limitation of the present study.

A significant ($p<0.05$) positive association was found for the changes in outdoor and indoor elemental concentrations observed at school B (the one with the most intense local traffic). No statistically significant association was identified for any of the three other schools. The data for school B are presented in Fig. 1. Elements such as Br and Cu that fell outside the plot are marked with arrows (the outdoor concentrations of these elements did not change significantly following the anti-idling campaign). For most elements measured at school B, the decrease in outdoor concentrations followed by a corresponding decrease in indoor concentrations.

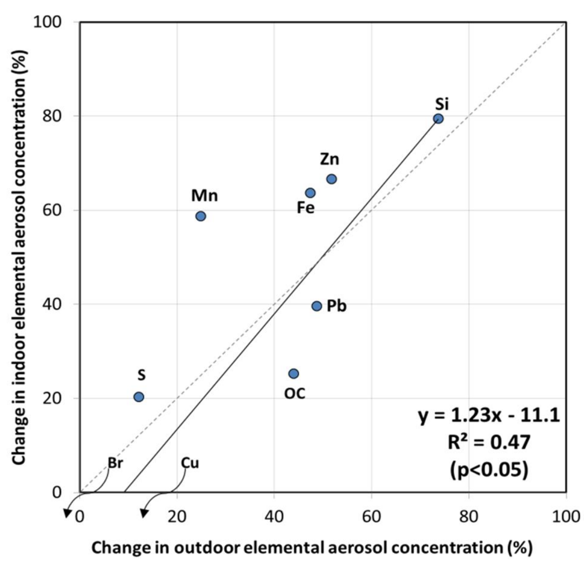

Fig. 1. Association between the changes in outdoor and indoor elemental concentrations at school B following the anti-idling campaigns. Elements detected at levels below uncertainty in at least 50% of samples were excluded.

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