Integrating Indoor Exposure to Fine Particulate Matter in Product-Oriented Impact Assessment

Fantke, Peter; Hodas, N.; Weschler, C.; Jolliet, O.; McKone, Tom

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to examine how changes in input parameters, such as vehicle counts or speeds, can affect air quality. Simplified or reduced-form models typically retain the same or similar algorithms most responsible for characterizing uncertainty in more sophisticated models. The Community Line Source modeling system (C-LINE) allows users to explore what-if scenarios such as increases in diesel trucks or total traffic; examine hot spot conditions and areas for further study; determine ideal monitor placement locations; or evaluate air quality changes due to traffic re-routing. This presentation describes the input parameters, analytical procedures, visualization routines, and software considerations for C-LINE, and an example application for Newport News, Virginia. Results include scenarios related to port development and resulting traffic changes. Areas and populations with potentially high impacts are identified, and differences in air toxics concentrations for the what-if scenarios are examined. These outputs are being used to identify potential risk reduction options for the neighboring communities, and to evaluate near-road impacts in the context of multiple other environmental health stressors, such as port emissions and coal ash.

Keywords: A-exposure models, C-air

Th-O-E1: Particulates Matter - I

Th-O-E1-01

Assessment of Particulate Matter Air Quality Impacts and Potential Health Risks Posed by an Urban Building Demolition Project

C. M. Long; Gradient, Cambridge, MA

Abstract: Despite the increasing occurrence of building demolition projects in highly populated urban areas, few published studies have investigated the ambient air quality impacts of today's structural building demolition practices. This study was conducted to characterize the off-site particulate matter (PM) air quality impacts and address PM-related health concerns from structural demolition activities for a multi-story building in urban Seattle, Washington. A network of three DustTrak DRX 8533 monitors was used to continuously measure PM2.5 and PM10 levels at two locations along the project fenceline and at a third location approximately 200 feet from the fenceline on a nearby property. PM monitoring was conducted for approximately a month for a baseline period prior to the start of full-scale demolition activities, and then for three months during periods of mechanical building demolition activity and the handling and removal of demolition debris. Diesel-powered equipment used during site demolition activities consisted of several excavators, including a high-reach demolition excavator equipped with a fire hose, and a mister. Key findings from this study support an absence of significant health risks from incremental PM2.5 or PM10 off-site air quality impacts due to demolition-related activities at the project site. For example, although likely confounded by differences in meteorological conditions and regional PM emissions, we observed reductions in average PM2.5 and PM10 levels and no exceedances of the U.S. EPA National Ambient Air Quality Standards (NAAQS) for the periods of active demolition activities as compared to the baseline monitoring period. Brief short-term peak PM2.5 and PM10 episodes were periodically recorded at the two fenceline monitors nearest the demolition site, but monitoring at the more distant third monitor revealed the general absence of either short-term peak or longer-term incremental impacts to PM2.5 or PM10 concentrations.

Keywords: C-air, B-particulate matter, A-sampling methods

Th-O-E1-02

Integrating Indoor Exposure to Fine Particulate Matter in Product-Oriented Impact Assessment

P. Fantke[1], N. Hodas[2], C. Weschler[3], O. Jolliet[4], T. McKone[5]; [1]Technical University of Denmark, Kgs. Lyngby, Denmark, [2]California Institute of Technology, Pasadena, CA, [3]Rutgers University, Piscataway, NJ, [4]University of Michigan, Ann Arbor, MI, [5]University of California, Berkeley, CA

Abstract: Fine particulate matter (PM2.5) pollution has been estimated to contribute more than 7% to the total global human disease burden from 1990 to 2013 (http://healthdata.org/gbd). Ambient (outdoor) and household indoor PM2.5 exposures are reported to account for 41% and 58% of this impact, respectively, emphasizing the need to include indoor exposure in overall estimates of health burdens. However, lacking clear guidance on how to consistently include health effects from indoor exposure to PM2.5 in a product life cycle perspective, practitioners fail to report related life cycle impacts. To address this gap, a global initiative has started to build an indoor exposure framework, including key impacting factors. Existing literature was reviewed for factors

influencing indoor exposure to PM2.5 and a model comparison has started for combining exposure to PM2.5 emitted indoors with exposure to PM2.5 formed indoors from chemical reactions. Indoor exposure to PM2.5 is driven by a combination of human-specific factors (e.g., breathing rate, time-activity patterns, occupant density), pollutant-specific factors (e.g., particle penetration efficiency, particle deposition rate, filtration efficiency, phase change, chemical transformation rates, distance between indoor emission source and human receptor), and building-specific factors (e.g., air exchange rate, type of ventilation system, mixing efficiency, surface-to-volume ratio). These factors are systematically built into a model parameterized for different archetypal indoor settings, such as specific residential and occupational settings. We also address how to possibly adapt exposure-response relationships derived from ambient PM2.5 concentrations for being combined with exposures from indoor sources. Our study constitutes a first step towards providing guidance on how to include health effects from PM2.5 indoor air exposures in product-oriented impact assessments.

Keywords: A-indoor environment, A-life cycle analysis, Intake fraction, air pollution, global guidance, Intake fraction, air pollution, global guidance, Intake fraction, air pollution, global guidance

Th-O-E1-03

Solubility of trace elements in Particulate Matter

K. M. Shakya, R. Peltier, P. Pant, F. Kiros; University of Massachusetts, Amherst, Amherst, MA

Abstract: Particulate matter is a diverse mixture of chemical elements which vary across space and time. Often, these samples are useful for investigating specific biological responses by utilizing extracted material from filters to assess in vitro or in vivo toxicity. Archived samples from Nepal, Vietnam, Kyrgyzstan, India, and northern Canada collected from 2013 to 2015 were quantified by X-ray fluorescence spectroscopy for 65 elements ranging from Na to U, including Cd, Cr, Mn, Ni, S, V, and Zn, present on collected filters. After aqueous extraction, filters were rinsed, dried, and reanalyzed for metals that remain on the filters. The solubility of elements was highly variable with the highest solubility usually observed from urban sites, though varied with each of the elements measured. The samples with the highest overall soluble fractions were collected in a personal sampling campaign in Nepal which focused on roadway exposures; highest solubility was observed in samples collected during the rainy monsoon season compared to winter. In residential sampling from Nepal, soluble fractions of these elements were generally larger in PM2.5 compared to PM10. Thus, solubility appears to depend on several factors, including emission source, meteorological parameters, and specific elements of interest. These finding warrant caution in the methodological interpretation of collected samples use where soluble metals are an important exposure source.

Keywords: B-particulate matter, B-metals, Chemical Characterization, Air Pollution, Toxicity

Th-O-E1-04

Characterization of personal exposure to PM2.5 and BC in various micro-environments in New Delhi, India

R. E. Peltier, P. Pant; University of Massachusetts, Amherst, MA

Abstract: Air pollution is increasingly becoming a critical threat throughout India where particulate matter (PM) concentrations are often found to exceed the air quality standards. While there have been many studies focused on personal exposure in Europe and North America, there are far fewer studies focused on exposure in developing countries where much higher ambient concentrations are frequently recorded. The objective of this study was to characterize personal exposure levels of PM2.5 and black carbon (BC) in New Delhi, India, and to generate novel data on PM exposure in various indoor and outdoor microenvironments. A pilot study was conducted in winter 2014 where volunteers were recruited to collect semicontinuous measures of PM2.5 (pDR-1500 nephelometer) and black carbon (AE51 microaethalometer) for a period of 48 hours. 24-hour integrated Teflon filters were also collected from the pDR, which were then analyzed for a variety of chemical species, including metals (ED-XRF) and ions (ion chromatography). During the same time period, limited indoor and ambient PM2.5 samples were also collected. Average ambient PM2.5 concentration in an urban residential location was recorded as 333.8 ± 145.5 µg/m3 while average personal exposure PM2.5 was recorded as 220.1 ± 68.2 µg/m3. Average BC concentrations for ambient, indoor and personal exposure were 19.3 ± 8.2 µgC/m3, 16.6 ± 4.97 µgC/m3 and 22.5 ± 14.9 µgC/m3 respectively. Several elements including As, Pb and Zn were found to be enriched across ambient, indoor and personal exposure samples. PM and BC were found to be correlated ($p<0.01$) for all samples and activities associated with the highest PM and BC concentrations included cooking, commuting and incense burning. Further chemical analysis for in vivo reactive oxygen species