12IA.2

Direct Measurements of Particle Decay Rates for Fine and Ultrafine Particles in 74 Residences in Edmonton, Canada.LANCE WALLACE, Jill Kearney, Morgan MacNeill, Warren Kindzierski, Marie-Eve Heroux, Amanda Wheeler, *US EPA (retired)*

Particle deposition rates are a fundamental determinant of indoor particle concentrations. However, these rates are not well known due in part to the difficulty of untangling the concurrent effects of infiltration, exfiltration, filtration by furnace fans and portable or in-duct air cleaners, and (for ultrafine particles (UFP) in particular) coagulation. Previous studies in multiple homes generally have been unable to determine deposition rates for individual homes, and have only provided an average rate for all homes in the study. In this large-scale study in Edmonton, Canada, a new method of separating indoor-generated from outdoor-infiltrated particles was developed.

Indoor and outdoor fine particles (FP) and UFP were measured for 7 consecutive days in both summer and winter in 50 residences per season. Continuous 1-minute average measurements were made by DustTraks (Model 8520, TSI, Inc., Shoreview, MN) equipped with 2.5 micrometer inlets and P-Traks (TSI, Model 8525). Air exchange rates were determined using the perfluorotracer (PFT) method. A censoring algorithm was developed to identify and remove peaks due to indoor sources. The remaining indoor concentrations were assumed to be due to infiltration of outdoor particles. The daily average infiltration factor could thus be determined. The product of this factor with the outdoor concentration provided the time-resolved estimate of the background concentration to which the indoor concentration was trending. For “well-behaved” (R^2>90%) indoor peaks, background-corrected decay rates could be determined. Subtraction of the air exchange rates provided an estimate of the deposition rates. About 400 (300) decay rates for UFP (FP) were determined in 60 (58) homes. On average, deposition and filtration accounted for about 75% of the total decay rates, the remainder being due to air exchange. These decay and deposition rate estimates for individual homes will allow a better estimate of distributions of rates across homes for modeling total indoor exposures.

12IA.3

Dynamic Modeling Study for In-cabin Ultrafine Particle Transport: Evaluation of Infiltration and Passive Ventilation in a Wide Range of Driving Speed. EON LEE, Michael Stenstrom, Yifang Zhu, *University of California, Los Angeles*

A few recent studies have proposed in-cabin ultrafine particle (UFP) models. However, these models did not incorporate infiltration and passive ventilation as a function of driving speed. This study presents a zero-dimension pseudo-steady-state model coupled with two sub-models describing infiltration and passive ventilation. The infiltration term was formulated using vehicle envelope leakage parameters (i.e., flow coefficient and pressure exponent) to address the dynamic behavior of infiltration as a result of the two competing processes: aerodynamic pressure on moving vehicle surface and mechanical cabin pressurization. The passive ventilation term was empirically derived from extensive field measurements. This model allows infiltration and passive ventilation to affect in-cabin UFPs at any driving speed in time. Model predictions agreed well with the experimental measurements in 12 different vehicle models as well as previously published data in the literature. In outdoor air (OA) mode, UFP I/O increases at increasing driving speed due to mechanical ventilation, passive ventilation, and infiltration. While mechanical ventilation dominantly controlled the I/O, passive ventilation and infiltration could also increase the I/O by 0.45 under fan off. In this case, surface deposition mechanism reduced the I/O in driving speed up to 60 and 90 km/hr in sedan and minivan, respectively. Above these driving speeds, passive ventilation and more importantly infiltration increased the I/O. When operating fan in OA mode, mechanical ventilation reduced the effects from infiltration and passive ventilation. Thus, in-cabin UFP concentration significantly changes by different particle gain/loss mechanisms and the magnitude of change depends on driving speed, ventilation condition, and vehicle type.

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