

THE EFFECTS OF AMBIENT OZONE EXPOSURE ON THE DISPERSION OF AN INHALED NaCl AEROSOL BOLUS IN EXERCISING ADULTS

PA. Jaques, GD Thurston, PL Kinney, M Lippmann
Nelson Institute of Environmental Medicine, New York
University Medical Center, Tuxedo, NY, USA

The aerosol bolus dispersion technique (ABDT) is a respiratory maneuver previously developed to indicate damage in small airways based on changes in the lung's effects on aerosol dispersion during respiration. In the ABDT, a bolus of submicrometer particles is injected into a subject's deep lung tidal breath of filtered air. It has been shown to be a sensitive measure of small airway functional changes after ozone chamber exposures (Am. Rev. Respir. Dis. 141(4): A72, 1990). However, we have now developed a NaCl based ABDT, which provides one of the safest possible test aerosols, and thereby broadens the subject group base in which the ABDT can be routinely employed.

As part of a larger ambient human pollution exposure study conducted for the U.S. EPA on Governors Island, NYC, NY, we conducted a study to assess the sensitivity and utility of the NaCl ABDT method in the field, and to test for small airway functional effects as a result of ambient ozone exposures. Nonsmoking healthy male joggers, who were Coast Guard personnel, were tested on multiple occasions between early July and late September 1993 for NaCl aerosol bolus dispersion, both before and after running. Real-time measurements of ambient ozone ranged between 10 to 145 ppb during the runs (with exercise times of about 20 minutes). During the ABDT maneuver, a 300 ml bolus of NaCl aerosol ($d_p = 0.4 \mu m$) was injected into a 2 liter tidal breath (0.67 liters/sec) at a 700 ml penetration depth. The dispersion effects are expressed as a change in: the first three moments of a normal distribution; the bolus volume half-width; particle deposition; and, the concentration peak-height. Each parameter is examined via regression as a function of ozone exposure for each individual subject and also collectively for all subjects. The field results are compared with past lab O_3 controlled exposure results. Conclusions are drawn regarding both the usefulness of this NaCl ABDT and the implied effects of ozone on small airways of the lung.

MODELING INDOOR CONCENTRATIONS OF ENVIRONMENTAL TOBACCO SMOKE (ETS) IN THE HOME

W. Ott, N Klepeis, P Switzer
EPA and Department of Statistics, Stanford University

This paper discusses the theoretical and practical development of a multi-compartment indoor air quality model designed for predicting pollutant concentrations from environmental tobacco smoke (ETS) in the home. The model is used to predict the time series of carbon monoxide (CO), respirable suspended particles (RSP), and polycyclic aromatic hydrocarbons (PAH) in response to different cigarette smoking activity patterns in a home with multiple rooms. The input parameters to the model are the cigarette source strengths, smoking activity patterns, room volumes, and compartmental air exchange rates. The parameters of the model are obtained for different configurations (bedroom door open, bedroom door closed, living room window open, living room window closed) by making measurements with real-time instruments in a test home. Field experiments are conducted in a test home with a cigar and a cigarette to evaluate the performance of the model, and real-time measurements are made of CO, RSP, and PAH. The time series predicted by the model are compared with the time series observed in the home, and good agreement between the model predictions and the observed time series is obtained. The applicability of this multi-compartment model for making predictions of ETS pollutants in other homes is discussed.

EXPOSURE TO PERCHLOROETHYLENE IN HOMES NEARBY DRYCLEANERS USING CLOSED SYSTEMS AND THE EFFECT OF REMEDIAL ACTIONS.

T. East
Municipal Health Service, Amsterdam, the Netherlands

The weekly averaged exposure to perchloroethylene in homes nearby twenty drycleaners (18 with a closed and 2 with an open system) was studied. Also a building of a former drycleaner, which moved 5 years ago, was included. Besides the indoor air measurements also the concentrations of perchloroethylene in soil, drinking water, food stuffs and mothermilk were measured. In 1984 a Dutch limit value of 2.5 mg/m³ was set for perchloroethylene, based on an (acute) effect level in workers. Recent epidemiological studies did not yield any evidence for carcinogenic or reproductive effects. So there is no reason to change the limit value.

High exposures clearly above this limit value occur, especially in the homes above the drycleaner: the median concentration was 2.2 mg/m³ and the maximum 29.9 mg/m³. In the shops beside the drycleaner the median value was 177 µg/m³. The median concentration in the ambient air was 127 µg/m³. The type of machine had no effect. However, the type of ceiling was very important. In homes above drycleaners with a concrete ceiling the median concentration was 10 times lower than the median concentration in homes above a drycleaner with a wooden ceiling. A polluted soil can contribute to the levels of perchloroethylene in the indoor air. However the most important route of transport both for the homes above as well as for the shops beside the drycleaner is transport within the building. In most cases the concentrations during the night were higher than those during the day as well as in the drycleaner as in the home above the drycleaner. Emission from the cleaned garments and turning off the ventilationsystem seems important. An effect of season was not found. With remedial actions, including repairing or renewing parts of the ceiling, a sufficient reduction of the concentrations in the homes above the drycleaner was not achieved. In practice it is difficult to accomplish a fully gastight ceiling.

MEASUREMENTS OF OZONE EXPOSURES IN SCHOOLS

E.L. Roberts and F.W. Lurmann, Sonoma Technology, Inc., 5510 Skylark Blvd., Santa Rosa, CA 95403

As part of a study to characterize possible chronic respiratory effects of air pollutants, we have measured ozone in classrooms and outdoors at schools in 12 Southern California communities. The purpose of this measurement program is to characterize indoor ozone concentrations and indoor/outdoor ratios in school, in order to provide information for assessing ozone exposure of school children. The 12 communities were selected to represent a range of ambient pollutant exposures.

The ozone measurements included 4-day average concentrations using a timed exposure diffusive (TED) microenvironmental sampler built and tested for this program, and hourly concentrations using conventional ozone monitoring technology. Average measurements using the TED sampler have been made four times in 48 schools in each of the 12 communities. These results are being used to characterize ozone concentrations indoors in classrooms as a function of ambient ozone concentration and temperature; and building characteristics such as construction materials, room size, type of ventilation system and method of operation, and ventilation rate. Hourly indoor and outdoor ozone concentrations were collected in several individual classrooms to obtain diurnal patterns of indoor ozone concentrations and indoor/outdoor ratios for various combinations of the two most important variables: type of ventilation systems and classroom construction material.

In the presentation, we will discuss the school ozone measurement program, the accuracy and precision of the TED sampler, comparison of the TED sampler and hourly monitors, a comparison of the results with nearby ambient monitor concentrations, a summary of how these data will be used in assessing ozone exposures for the school children, and recommendations for future studies.

AIRLINE PASSENGER EXPOSURES TO TOBACCO SMOKE PAHS AND NICOTINE

R. Williams¹, S. K. Hammond², R. Watts³, J. Lewtas³
¹ILS, RTP, NC, ²U.Mass. Med. Center, Worcester, MA, ³US EPA, RTP, NC

A study was conducted that sought to correlate cotinine excretion in passengers exposed to environmental tobacco smoke. As a part of this study, active ambient air samplers equipped with either a multi-stage filter pack or size selected inlet were used to collect total or respirable particulate matter along with vapor phase nicotine aboard passenger aircraft where smoking was allowed. Four transcontinental flights, having an average of 4 hour flight duration, were selected for monitoring. Nine respondents (4 flight attendants, 5 passengers) wearing personal monitoring devices participated during each flight with passengers seated strategically in smoking, nonsmoking and border sections (seats adjacent to smoking sections). Stationary area sampling (monitors located in positions close to participants) was also conducted.

Polynuclear aromatic hydrocarbons (PAHs) from filter sample extracts were determined with an optimized HPLC methodology utilizing UV and time-programmed fluorescence detection. This method resulted in quantitation of nearly all the 16 selected PAHs where ambient air concentrations were above 0.1 ng/m³. Carcinogenic PAH levels were observed in the highest concentrations in smoking and border seating areas (0.8-12 ng/m³). Nicotine was quantified at levels above 0.07 µg/m³ using a GC/NPD procedure. Concentrations as high as 7.1 µg/m³ of nicotine were observed for some smoking and border seating sections. No statistical differences were observed between smoking and nonsmoking sections with respect to nicotine concentrations. Overall carcinogenic PAH concentrations were determined to moderately correlate ($r^2 = 0.64$) with ambient nicotine levels. This abstract does not necessarily reflect EPA policy.

HOW MUCH DUST AND LEAD ARE IN AN OLD CARPET? MEASUREMENT AND CONTROL

J. Roberts, G Glass, T Spittler
Engineering Plus, Seattle, Washington, USA

This study used standard vacuum cleaners to measure the lead (Pb) as well as the total and fine dust (< 150 microns) that could be removed from 11 area and ten wall-to-wall carpets. Questionnaire data on related variables were taken in each house. The sampled surface of all carpets were vacuumed eight times as in ASTM method F608-79. A second bag was placed in the vacuum and wall-to-wall carpets were vacuumed 32 times in the same sample area. Area rugs were inverted and all of the surface area vacuumed three times on each side using a second bag at the rate of three min/m². The dust was sieved through a 100 mesh sieve, weighed, and analyzed for Pb using energy dispersive x-ray fluorescence. Plugs were taken from a cleaned wall-to-wall carpet, ground up, and analyzed for Pb.

Normal vacuuming would remove a small percentage of the dust and Pb found in these rugs compared with intensive vacuuming done in this study. The average percentage of fine dust removed during the second cleaning of area rugs (78%) was higher than found in wall-to-wall carpets (62%). A second sampling of a set of the such rugs taken six weeks after the first sample is reported. The total amount of Pb and dust was estimated for each area rug and in the area sampled for wall-to-wall carpets. The significance of the data and correlation between Pb exposure in carpets and related variables are reported. The limitation of the study and the cost effectiveness of various cleaning methods are discussed.