The results will show how multizone modeling tools can be used to assess contaminant transport within passenger aircraft and to estimate how engineering controls can be used to mitigate the effects of contaminants.

209.

ASSESSMENT OF CONCENTRATION AND VELOCITY FIELD USING COARSE GRID. S. Tamanna, M. Ahmed, E. Lee, C. Feigley, J. Khan, University of South Carolina, Columbia, SC.

Assessment of exposure in industrial hygiene is an important concern. In order to perform contaminant exposure assessment in a workroom, it is necessary to predict the steady state concentration distribution in a room as a function of room-air exchange rates and ventilation air inlet and outlet locations. Existing model equations do not always predict the spatial concentration variations to the desired accuracy. As a result, in an alternate approach, the analysis of flow field and assessment of concentration in the room is determined by computational fluid dynamics simulations with fine grid. This approach can be computationally expensive and very time-consuming, particularly for three-dimensional cases. Researchers in the past have studied multi-zonal method and even coarse grid (for 2-D cases) CFD simulations to minimize the computational cost at the same time keeping the accuracy of predicted results within reasonable error limits. In this paper, a similar approach has been taken where 3-D CFD simulations are performed for various ventilation flow rates and relative contaminant source, inlet, and outlet locations of the ventilation air. In order to reduce the time requirement for CFD analysis, coarse grid simulations have been studied for three cases: two-dimensional, semi-two dimensional, and three-dimensional, and these data have been compared with the fine grid CFD simulations. The analyses show that two-dimensional and semi-two dimensional cases can have good agreement with fine grid solutions for both velocity profile and concentration estimates. In three-dimensional cases, the coarse grid simulation method provides reasonable results only in rooms that are geometrically symmetric. For most other rooms, CFD results do not show satisfactory agreement in assessing concentrations, whereas velocity profiles show better agreement than concentration in three-dimensional cases. This paper presents several CFD results with varying grid sizes and some experimental results to demonstrate the validity of the conclusions obtained.

210.

EFFECT OF FURNITURE PRESENCE ON OPTIMUM RELATIVE LOCATION OF INLET AND EXHAUST AND ON INDOOR AIR CONTAMINANT CONCENTRATION. M. Ahmed, S. Tamanna, E. Lee, C. Feigley, J. Khan, University of South Carolina, Columbia, SC.

The relative location of air inlets and exhausts ventilation ports, presence and locations of heat and contaminant producing sources, and the presence of flow obstructing furniture are some of the important factors which affect the distribution of contaminant concentration in a workroom. This paper presents an extension of our previous work where several different inlet and exhaust locations without furniture presence were investigated. In this paper we have attempted to determine if the presence of furniture and heat-producing sources affect the optimum inlet and exhaust locations which was previously studied without the presence of furniture. Room concentration patterns for a workroom were explored by computational fluid dynamics simulations for various inlet locations, exhaust locations, with furniture and dilution air flow rates. Thermal effect for worker presence, computers, and lights on were also investigated. Average contaminant concentrations were calculated for the entire room, the breathing zone plane, and the near-source breathing zone.
It was found that the presence of furniture does not affect the optimum location of inlets and exhausts provided the furniture does not directly obstruct the exhausts. For wall jet inlets when the exits are on the right or left sidewalls, contaminant concentration is affected by the presence of furniture. This is because the incoming jet is diverted by the furniture. When the inlets are on the sidewalls, presence of furniture results in higher contaminant concentration but the reverse is true for ceiling inlets. Light sources present in the ceiling appear to have less effect on the concentration, because the buoyant plumes created by the light tend to not affect the rest of the flow, whereas the presence of computers on a desk did affect the concentration if the buoyancy-driven flow changed the overall flow pattern.

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211.

A VALIDATION SCHEME FOR DIFFUSION DOSIMETERS USING GRADIENT ANALYSIS. J. Cross, ChemCounsel Corporation, Houston, TX.

Diffusion dosimeters are well-accepted for their ease of use and the promise of accuracy implied by their adherence to Fick's First Law. In practice, however, performance differs from promise. Dosimeters with short diffusion paths have been found to deviate from predicted performance. This deviation has meant that dosimeter performance could not be predicted and that validation schemes had to be empirical. More importantly, the parameters controlling sampling rates could not be clearly characterized. Both of these conditions have, in the opinion of the author, prevented fuller use of dosimeters. Recently, the development of Gradient Analysis has demonstrated a better way to apply Fick's law to dosimeters. This paper extends Gradient Analysis to describe a validation scheme that significantly reduces the validation effort and at the same time increases understanding of the mechanisms controlling the sampling process.

The validation scheme begins with separating the sampling process from the adsorption process. This is possible, because the analytical method associated with Gradient Analysis does not depend on the properties of the adsorbent. Separating the sampling device from the adsorbent divides the validation process into two more-easily-managed efforts. Two critical adsorbent properties, capacity and rate of adsorption, will be discussed as they relate to sampling conditions encountered in the field. The parameters of the sampling process that will be discussed include predicting the sampling rate (the calibration factor), determining the effect of inadequate airflow, correcting for airflow effects encountered in a specific application, checking the validation at periodic intervals, and validating a dosimeter for multiple compounds.

212.

GOING FISHING? OSHA HAS A NEW FULLY VALIDATED DIFFUSIVE SAMPLING METHOD FOR SIXTEEN OF OUR TOP VOLATILE ORGANIC CHEMICAL SUBSTANCES. W. Hendricks, G. Schultz, U.S. DOL/OSHA, Salt Lake City, UT.

OSHA researchers have developed a new sampling and analytical method to measure low-level occupational exposures to moderately volatile organic chemical substances. The new method features diffusive sampling with analysis by thermal desorption and GC/mass spectrometry. The analytical technique permits simultaneous identification and accurate quantitation of many chemical substances that are often encountered in sampling previously uncharacterized workplace atmospheres. The method is intended for use to monitor exposures of one part-per-million or less with sampling times as long as eight hours. The new method represents a significant departure from traditional methods that are typically validated for only one substance at a high level. Low levels of many substances are difficult to monitor with traditional methods and exposure to these low levels often cause adverse health effects and employee complaints. Diffusive sampling

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