

3.2 Laboratory and field experiments

3.2-1 Transmission characteristics of passenger-exhaled droplets in a simulated air-cabin environment

MP Wan¹, CYH Chao^{1*}, L Fang²

¹Department of Mechanical Engineering, Hong Kong University of Science and Technology, Hong Kong

²International Centre for Indoor Environment and Energy, Technical University of Denmark, Denmark

*Email: meyhchao@ust.hk

Experimental investigations on the transmission characteristics of droplet phase aerosols were performed in an aircraft cabin mock-up facility at the Technical University of Denmark. The air distribution system in the mock-up facility was built to simulate the actual cabin environmental control system. Heat simulators were utilized to simulate passenger heat loads. A droplet generator was set at one of the seats to simulate a coughing passenger. Results showed that fewer droplets were dispersed to other seats when the droplets were released at a seat next to the cabin wall compared to that at the center seats, suggesting that the downward air flow at the side seat suppressed the dispersion of droplets while the upward air flow at the center might enhance the dispersion. Higher supply airflow rate and lower relative humidity (RH) reduced the dispersion of droplets. This might be caused by stronger dilution induced by higher airflow rate and enhanced evaporation at low RH.

3.2-2 The effect of an occupant's presence in a room on pollutant dispersion

E Lee^{1*}, CE Feigley¹, J Khan², M Ahmed², S Tamanna³

¹Department of Environmental Health Sciences, Arnold School of Public Health, University of South Carolina, Columbia, SC 29208, USA

²Mechanical Engineering Department, University of South Carolina, Columbia, SC 29208, USA

³Philadelphia Mixing Solutions, Palmyra, PA 17078, USA

*Email: eunglee@gwm.sc.edu

The pollutant dispersion pattern was investigated in an experimental room to determine if an occupant's presence can influence the distribution of pollutant concentration throughout the room, and thus affect the potential exposure levels of others in the room. It was found that the occupant's presence influenced the dispersion pattern in the occupied portion of the room for all conditions investigated, except for the ceiling diffuser-inlet/91.7 lsec⁻¹. For the wall jet-inlet/91.7 lsec⁻¹, concentrations near the source were higher for all occupant locations than when no occupant was present. Interestingly, when the occupant was located toward the room's north side, a high-concentration area was observed near the floor for both inlets at a ventilation flow rate of 55.0 lsec⁻¹. Here it appeared that the natural convection was the dominant influence in this part of the room. This study indicates that pollutant dispersion patterns in an occupied, ventilated room depend upon the location of the occupant and the occupant's interaction with the velocity field.

3.2-3 Pollutant distribution due to thermal forces in a high building

T Follin*

Carl Bro Barab, Propellervägen 6A, 183 62 Täby, Sweden

*Email: Tom.follin@carlbro.se

In a high building in Stockholm the employees suffered from Sick Building Syndrome (SBS) symptoms. An Indoor Air Quality (IAQ) investigation started with a questionnaire survey. It showed that almost

all complaints originated from the three top floors. As building materials, support air quality and type of work was equal in all floors we suspected that the reason to the complaints couldn't be found in the top floors. We found that contaminated air entered vertical spaces through the building in the cellar floors. Due to thermal forces the air was transported upwards. Close to the top of the building the air pressure in the vertical spaces was higher than it was in the surrounding office apartments and the air was leaking from the vertical air spaces in to the office apartments. All contaminations and their sources are taken care of. A follow up questionnaire survey shows good results.

3.2-4 Effects of building recirculation rates on secondary organic aerosols generated by indoor chemistry

MS Zuraimi^{1*}, CJ Weschler^{2,3}, KW Tham¹, MO Fadeyi¹

¹Department of Building, National University of Singapore

²International Centre for Indoor Environment and Energy, Technical University of Denmark, Lyngby, Denmark

³Environmental and Occupational Health Sciences Institute, UMDNJ/Robert Wood Johnson Medical School & Rutgers University, Piscataway, NJ, USA

*Email: bdgzms@nus.edu.sg

Numerous investigators have documented increases in the concentrations of airborne particles as a consequence of ozone/terpene reactions in indoor environments. This study examines the effect of building recirculation rates on the concentrations of secondary organic aerosol (SOA) resulting from reactions between indoor limonene and ozone. The experiments were conducted in a large environmental chamber using four recirculation rates (11, 14, 19 and 24 ACH) and a constant outdoor air exchange rate (1 ACH) as well as constant emission rates for limonene and ozone. As the recirculation rates increased, the surface removal rate of both ozone and SOA increased. Due to both of these factors – the lower ozone concentrations and the larger surface removal rates for particles – number- and mass-concentrations of particles in different size-ranges decreased significantly at higher recirculation rates. The size-distribution of the particle number-concentration (less so the particle mass-concentration) also changed with changing recirculation rates, shifting towards larger particles and a broader spread in the distribution at larger recirculation rates. The results have health implications since particle size to some extent determines where a particle deposits in the respiratory tract.

3.2-5 An experimental study of thermal plumes of kitchen appliances

R Kosonen^{1*}, H Koskela², P Saarinen²

¹Halton Oy, Haltonintie 1-3, 47400 Kausala, Finland

²Finnish Institute of Occupational Health, Lemminkaisenkatu 14-18 B, 20520 Turku, Finland

*Email: risto.kosonen@halton.com

In the kitchen environment, pollutant fumes of the cooking process are released into the ambient air in the convection plumes. The practical problem is to compute the requested extract air flow rate to maintain good indoor air quality in an energy efficient manner. In the most accurate design method, the design of a kitchen ventilation system is based on the flow rate in the thermal plume. The heat load is assumed to be a point heat source and the velocity and temperature profiles are approximated to be Gaussian distributed. In commercial kitchens, the location of the extraction point is at a height of 0.9–1.4 m above the heat source where