Microenvironment Around Persons in Rooms with Personal Ventilation

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Key Features

The personal microenvironment with personal ventilation…

- There is a complex interaction between the PV jet and the thermal plume in a person’s microenvironment.

- Many parameters/features may be important when examining the region around a person:
  
  **Orientation of PV system**
  - Effects velocities and pollutant concentrations in the BZ

  **Pollutant Transport (location of source)**
  - Effects pollutant concentrations in the BZ

  **Breathing (methods used to model)**
  - Inhalation and exhalation may effect local flow patterns and reinhalation

  **Chemical Reactions**
  - Effects pollutant concentrations in the BZ
The results shown are for two PV systems…

- The PV systems include:
  - Single round jet that direct fresh air toward the BZ.
  - Novel low-mixing Co-flow nozzle (Khalifa & Glauser, 2006) that direct fresh air toward the BZ.
Orientation of PV System

*PV creates velocity and concentration gradients in the personal microenvironment…*

- PV can significantly change the air quality in the microenvironment and creates velocity and concentration gradients in the BZ.

- Realistic alignment of PV systems can achieve better air quality over a wider region of the microenvironment.
Pollutant Transport (Location of Source)

Sources in the indoor environment produce concentration gradients in the room which effect the concentration distribution in the microenvironment…

\[ iF = \frac{\sum \text{Intake of pollution by an individual (mass)}}{\text{Mass released to the environment (mass)}} \]

- Pollutants emitted from surfaces in the indoor environment produce concentration distributions that are not well mixed.
Breathing Simulation Methods

Inhalation and exhalation had an effect on the local concentration and velocity fields, but steady state conditions were restored prior to re-inhalation…

- iF comparisons for a detailed manikin with four indoor sources with
  - S.S. no breathing (volume average),
  - S.S. no breathing (surface average),
  - S.S. inhalation and
  - Unsteady sinusoidal breathing
Chemical Reactions

The addition of volumetric reactions and wall adsorption increases concentration gradients in the room and near the person...

\[ \text{O}_3 + \text{C}_{10}\text{H}_{16} = \text{P} \]

- Significant variations due to imperfect mixing, concentration variations leading to different reaction rates at different locations and different ages of air which allows more time for reaction to occur at different locations.
Conclusions

The personal microenvironment with personal ventilation…

- There are many factors that create gradients in the microenvironment around a person that lead to complex interactions in this region.

  Neglecting these factors and assuming well mixed conditions can lead to serious error when examining different exposure scenarios.