IAQ Workshop
Assessing Common IAQ Contaminants and Ventilation Systems

Dru Sahai
Public Health Ontario
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Outline

• Introduction
  • Carbon monoxide
  • Thermal comfort parameters
    • ventilation, relative humidity, temperature, air movement
  • Sources
  • Health Effects

• Sampling and Interpretation
  • Sampling methods
  • Reference values
  • Interpretation

• Management
  • Ways to reduce exposures
Carbon Monoxide: What is it?

- Produced during incomplete combustion
- Dangerous gas – can cause serious illness and death
  - frequent fatalities
- Odourless/tasteless, colourless, non–irritating
- CO is inhaled and diffuses into the blood system
- Binds to haemoglobin (COHb)
  - very strong bond (245 x that of O₂)
  - cumulative exposure
Carbon Monoxide: Sources

• Sources include
  • automobile exhaust – garages, traffic, ice arenas, indoor go-kart racing
  • unvented or improperly vented (gas stoves, wood stoves or fireplaces, kerosene heaters)
  • ETS
  • improperly located air intakes (driveways, loading docks, garages)
Carbon Monoxide: Health Effects

• Health effects include
  • mild headache (50 ppm and above) to severe headache (above 200 ppm); lack of alertness
  • weakness, dizziness, nausea, fainting (above 400 ppm);
  • increased heartbeat, irregular heartbeat (above 1200 ppm);
  • loss of consciousness and finally death (above 2000 ppm).
Carbon Monoxide: Sampling Methods

• Air sampling to determine level
• Direct reading instrument
  • Colour diffusion tubes
  • Single chemical detector
  • Multi-parameter instrument
Carbon Monoxide: Reference Values

Health Canada guideline

- Long-term [8 hour]: 10 ppm
- Short-term [1 hour]: 25 ppm
Carbon Monoxide: Interpreting Results

• Consider:
  • Sampling method
    • accuracy
    • interfering gases

• Reference values
  • compare results reference values taking into account background levels
  • background levels can be as high as 10 ppm in urban areas
Carbon Monoxide: Management

• Install and maintain monitors
• Identify CO sources outside the building such as vehicles left idling
• Check location of air intake
  • near traffic or combustion sources
• Is fuel powered equipment being used indoors?
• Is fuel-burning heating equipment properly vented?
Thermal comfort parameters

- Ventilation
- Relative humidity
- Temperature
- Air movement
- ASHRAE 55
  - 80% of people don’t express dissatisfaction
Thermal comfort: Ventilation

• A ventilation system involves the supply, distribution and removal of air
  • must allow sufficient fresh air to enter a building, circulate to the occupants and exhaust polluted air

• Mechanical ventilation
  • forced air system

• Natural ventilation
  • windows, doors, cracks
Lack of fresh air and complaints

- Tiredness
- ENT irritation
- Nausea
- Drowsiness
- Stuffiness/stale air

Characteristic :
- symptoms develop within a few hours of being in the building and feel better after leaving the building
Sampling

• CO₂ serves as a general indicator for assessing the indoor air quality (Scheff et al., 2000).

• Specifically, CO₂ is used as a marker for ventilation efficiency
  • indicating whether sufficient outdoor air is being delivered to occupied spaces

• If there is not enough fresh air entering, the CO₂ will build up.
  • will vary depending on the # of people
  • peaks at lunch and in the late afternoon

• Measure CO₂ throughout the day and compare it to the standard
Sampling Methods

• Direct reading instrument
• Measures air velocity, temperature, humidity (RH), CO, CO₂
Carbon Dioxide: Reference Values

- The generally recommended guideline for CO$_2$ is 1000 ppm – EPA/DHHS
  - > 1000 ppm is correlated with complaints
- Health Canada has a guideline of < 850 ppm
  - ≈ 20 cfm of outdoor air/person
- Density of 5 persons/1000 ft$^2$
Carbon Dioxide: Interpretation

• If the CO$_2$ level is 850 - 1000 ppm, it is an indication that there is enough outside air entering the building. This is assuming the CO$_2$ test was performed under normal building occupancy conditions.
Thermal Comfort: Air movement

• Drafts caused by excessive air movement (AM) is a common complaint

• Constant rather than fluctuating AM

• Retrofitting an area without regard to the ventilation system will lead to
  • a lack of air movement
  • complaints of stuffiness
  • too hot or too cold
Air movement: Reference values

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ASHRAE (52-2010)
Thermal Comfort: Relative Humidity

• Some RH required for comfort

• too high (>60%)
  • biological growth
  • “musty”

• too low (<20% - 30%)
  • dry ENT membranes (nose bleeds)
Relative Humidity: Reference Values

• 40% - 60% generally recommended
  

• However in Canada, too much RH in heating season is problematic because of window condensation
  
  • 30% - 50% recommended
  
  • Below -10°C (14°F) outdoors, recommended indoor RH is 30%

  *Source: CMHC*
Thermal Comfort: Temperature

- Satisfactory indoor temperature varies according to:
  - Individual preference
  - Type of indoor environment
  - Clothing worn
  - Degree of activity
Temperature: Reference Values

- Temperature for thermal acceptability for sedentary or slightly active person
  - Summer (thin clothing):
    - 24.5 - 27.5 C @30% RH
    - 24.2 - 27.3 C @40% RH
    - 24.0 - 27.1 C @50% RH
    - 23.8 - 27.0 C @60% RH
  - Winter (thick clothing):
    - 21.0 - 25.7 C @20% RH
    - 20.6 - 25.2 C @30% RH
    - 20.3 - 25.0 C @40% RH
    - 20.0 - 24.7 C @50% RH

Source: ASHRAE (52-2010)

- Try for a constant temperature
  - Maximum temperature fluctuation rate (2.2°C/hr)
Ventilation: Management

• Make sure the HVAC system is appropriately sized for the facility
  • Be wary of recent renovations
  • Maintain an appropriate level of clean outside air
    • The goal should be to maintain indoor CO₂ levels below 1000 ppm
    • A general rule of thumb is that fresh air intake louvres should always be opened a minimum of 10%

• Make sure air supply and intake openings are not blocked
Thermal Comfort: Management

• Consider these other factors:
  • Check to make sure thermostats and humidity sensors are correct
  • Use blinds, perimeter heating and well-insulated windows
  • Before retrofitting/reconfiguring an office space, consider the impact on the HVAC system
    • HVAC engineering contractor to redesign and balance the system
  • Are humidifiers cleaned and maintained regularly?
Assessment steps

Initial Investigation
- Gather background information
- Building assessment
- Talk to occupants
- Standard measurements

Define the problem
- Review complaints
- Review HVAC system
- Identify sources of contamination

Make Corrections
- Institute changes to mitigate the problem
- Validate corrective action is working

Monitor the situation
Case study

- Students and staff are complaining about an odor that is particularly noticeable in the mornings just before school starts, then dissipates, then reappears in the afternoons just before school ends
  - Doesn’t happen on the weekends
  - Complaints of mild/severe headaches, tiredness/not being alert

- Identify the potential cause of the problem and how you would resolve it.
Case study

• A hospital needed to create a large reception and public waiting area.
• They retrofitted an existing open cubicle space by adding new walls.
• After construction was finished, the public and staff complained of headaches and stuffiness and being too hot.
• Identify the potential cause of the problem and how you would resolve it.
Additional Resources:
Environmental public health indoor air quality manual
A guide for environmental public health professionals
Environmental Public Health
August 31, 2012
Alberta Government

Questions?

Dru Sahai
Public Health Ontario
Dru.sahai@oahpp.ca
647-260-7784