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IAQ Workshop

Assessing Common IAQ Contaminants and Ventilation Systems

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Public Health Ontario

Indoor air quality workshop | CIPHI National Meeting
Winnipeg, MB | June 22, 2013

Ontario
Agency for Health Protection and Promotion
Agence de protection et de promotion de la santé

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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

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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 O_2)
  - cumulative exposure

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Carbon Monoxide: Sources

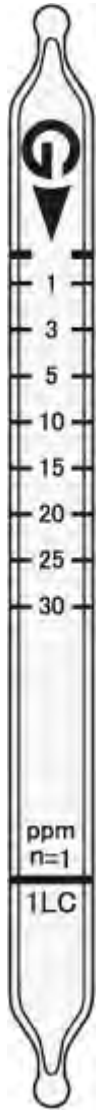
- Sources include
  - automobile exhaust – garages, traffic, ice arenas, indoor go-kart racing
  - unvented or improperly vented (gas stoves, wood stoves or fireplaces, kerosene heaters)
  - ETS
  - improperly located air intakes (driveways, loading docks, garages)

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



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Carbon Monoxide: Reference Values

Health Canada guideline

- Long-term [8 hour]: 10 ppm
- Short-term [1 hour]: 25 ppm

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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

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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

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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

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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

- CO_2 serves as a general indicator for assessing the indoor air quality (Scheff *et al.*, 2000).
- Specifically, CO_2 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 CO_2 will build up.
  - will vary depending on the # of people
  - peaks at lunch and in the late afternoon
- Measure CO_2 throughout the day and compare it to the standard

Sampling Methods

- Direct reading instrument
- Measures air velocity, temperature, humidity (RH), CO, CO_2

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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

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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.*

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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

°C	m/s	°F	FPM
25.5	0.8	77.9	160
25	0.65	77	125
24.5	0.47	76.1	90
24	0.33	75.2	60
23.5	0.25	74.3	45
23	0.21	73.4	35
22.5	0.15	72.5	30

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

  Source: Engineering Interface Limited, Healthy Building Manual: Systems, Parameters, Problems and Solutions, Energy, Mines and Resources Canada, Ottawa, May 1988

- 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

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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)

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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 CO_2 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

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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?

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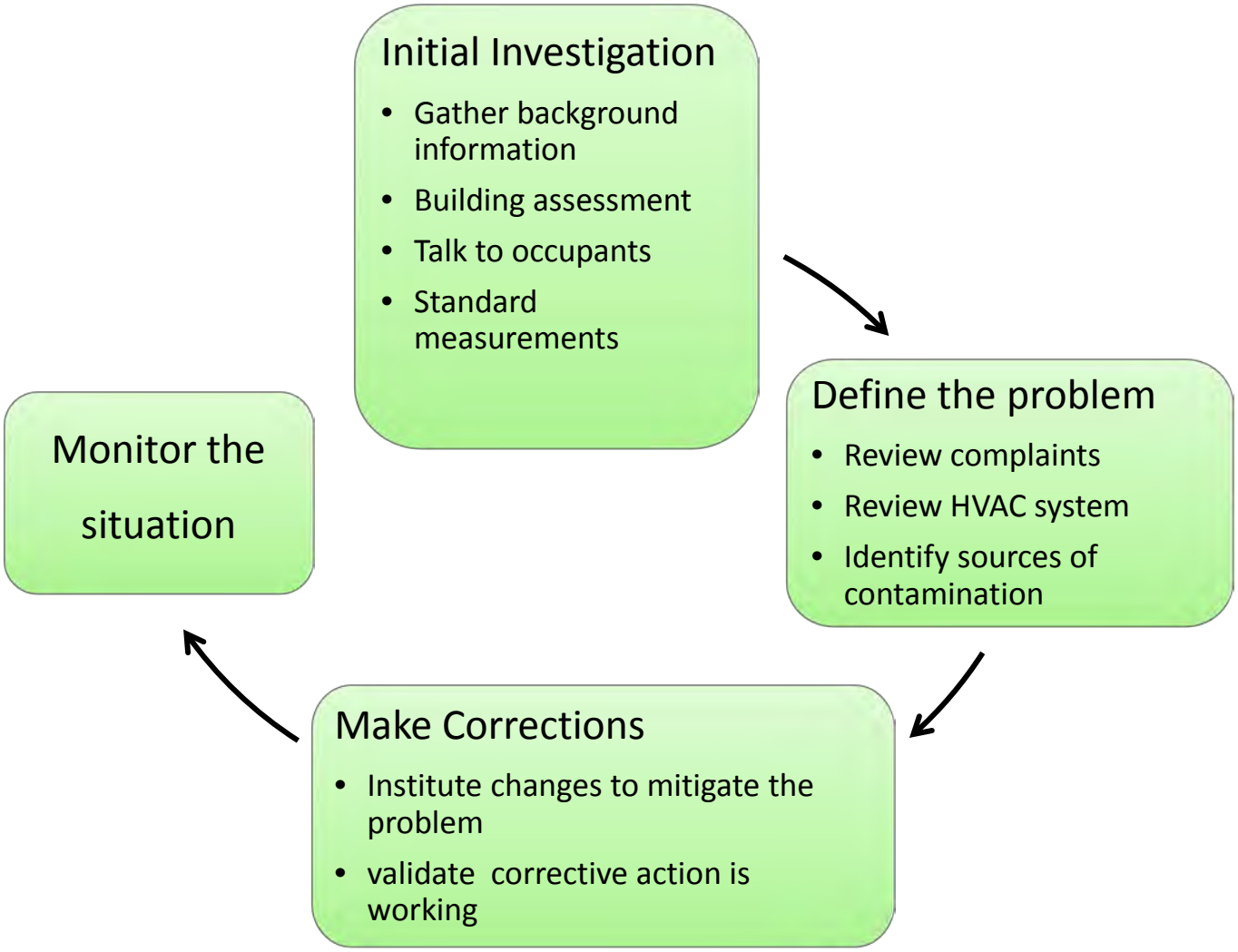
Assessment steps



Case study

- Students and staff are complaining about an a odour 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.

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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

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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?

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