Nick Drouin ▸ APQ - Action parentale Quebec 2020

3 hrs ·

PPM question for solution

chemistry Sec IV

CO2 vs. HEPA vs. Fresh Air: Some background.

Traditionally, classroom air quality is measured via the parts per million of CO2. You would want fewer parts per million of CO2 (ppm of CO2), something that resembles the normal level of CO2 outside. CO2 is added to the air as occupants of a room exhale, and CO2 ppm will add up over time.

In mechanically ventilated buildings, there is a fresh air damper / louver which mixes fresh air with the air that is recirculated around the building. That fresh air needs to be heated up to room temperature (or cooled in the summer, or not if there is no AC).

In the winter, most modern or upgraded mechanically ventilated systems have a CO2 ppm detector attached to an automated system to open/close the fresh-air intake. It only allows enough fresh air to meet the maximum allowed ppm of CO2. That is, it optimizes for as little fresh air as required to keep heating costs under control. These are called 'demand controlled' systems.

Here in Quebec, the guidance to school boards is to turn off the demand control system and allow as much fresh air in as possible. The term 'as possible' is problematic, because obviously the max intake might bring in so much air that the heating systems cannot keep up. So, implicitly, as much 'as possible' becomes constrained by the heating systems maximum output.

Demand control systems should be reprogrammed to ensure maximum fresh air flow while maintaining a minimum temperature (say 19C or 20C) in the classrooms. That is, do not control them with ppm CO2, but with temp. Many modern systems are centralized and can be reprogrammed as such.

In naturally ventilated buildings, fresh air is mixed with classroom air by opening the windows periodically. Ever felt sleepy late afternoon in class: probably because the windows were not opened periodically, or

class: probably because the windows were not opened periodically, or partially.
Closed, crowded and close-contact: pretty much describes our classrooms. Fresh air addresses the 'closed' part of the "three C's".
Now onto HEPA:
HEPA filtration does nothing for the CO2 levels in class.
When filtration is not present, then CO2 ppm can be equated to covid-particule concentration. If there is one (or more) person(s) that has covid, the more they breath out the more there is CO2 there is in the air. If everyone has masks, then there would be less particulates floating around. If there are no masks, the covid particle load will be highter. Lots or diagrams out there illustrating this, I wont be adding any here. The take-away is that the more people breath, the more CO2 there is and the more covid is in the air.
The more you swap (or dilute) the classroom air with fresh air, the less CO2 and covid will be in the air. There is a relatively fixed ratio between CO2 concentration and covid -- this is why you are seeing lobbying and initiative for adding CO2 ppm detectors to classrooms to inform the discussion.
However, as soon as you add filtration, then the ratio of CO2 to covid diverges. As mentioned above, the HEPA filters remove particles from the air, they do nothing about CO2 molecules -- so fresh air is still needed.
Conversely, when you replace the classroom air with fresh air, you both address CO2 and covid-particle concentration.

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Conversely, when you replace the classroom air with fresh air, you both address CO2 and covid-particle concentration.
This is why it is more important to ensure more fresh air than it is to install filters. If the heating systems can't keep up, to the fresh air needed to get to enough air changes per hour, that is when filtration should be added.
The balance to be struck is between enough air changes per hour (ACH) from fresh air to reduce CO2, this is limited by occupant comfort and the output of your heating system; plus the effective ACH from filtration. The total ACH target should be 5 ACH or better -- again lots of trade-offs trying to attain this including: the volume of air in the classrooms, the temperature of the air in the class versus outside, how much windows are opened, and what the wind-speed is.

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Take-aways:
1. Has your school-board or CSS implemented the recommendations to turn off demand-controlled fresh air, or reprogrammed it for temperature-based modulation for mechanically-ventilated schools?
2. What is their window-opening schedule for naturally ventilated schools?

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1. Has your school-board or CSS implemented the recommendations to turn off demand-controlled fresh air, or reprogrammed it for temperature-based modulation for mechanically-ventilated schools?
2. What is their window-opening schedule for naturally ventilated schools?
3. Per their calculations, are they achieving 5 ACH in the classrooms, if not, what type of filtration are they adding to mitigate?

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