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Carbon Dioxide and Carbon Dioxide Monitors – Your Questions Answered

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1. Carbon Dioxide

Carbon dioxide, known as CO_2, is a naturally occurring gas in the atmosphere and is important with regard to the environment and climate. It is generated by natural processes and human activities. Humans are one of the largest sources of indoor carbon dioxide. By breathing, the body cells take in oxygen to complete a process called cellular respiration. During this series of chemical reactions, the body produces carbon dioxide, which it releases through exhaling. Typically this carbon dioxide disperses into the air but in rooms with no ventilation the CO_2 has nowhere to go.

2. The best way to deal with carbon dioxide

The best way to reduce indoor CO_2 is to dilute it with fresh air. If a room feels stuffy, open a window to release any excess carbon dioxide. Outdoor air concentrations are approximately 400-480 parts per million (ppm).

3. CO_2 Levels and SARS-Covid -2

In the context of SARS-CoV-2 transmission, CO_2 measurements are not a reliable proxy of risk to airborne exposure to the virus (SAGE, 2020). Nevertheless, CO_2 measurements can be used to identify poorly ventilated multi-occupancy spaces. However CO_2 measurements are a less reliable measure of ventilation performance in single or low occupancy spaces or in very large spaces (SAGE UK[1], 2020, AIVC, 2021). Both the AIVC[2] and CIBSE[3] advise that CO_2 concentrations above 1400 – 1500 ppm are likely to be indicative of poor ventilation (CIBSE, 2020, AIVC, 2021).

4. Measuring CO_2

It is possible to measure CO_2 levels with a CO_2 monitor. The use of CO_2 monitors can provide a useful general indication that areas/rooms may not be adequately ventilated and can enable occupants to become familiar with the impact that activities, outdoor weather and window openings have on levels of good ventilation within a room.

5. Different Types of CO_2 Monitors

CO_2 monitors come in many shapes and forms, it is important that they are CE Marked and that the sensor in the unit is based on non-dispersive infrared (NDIR) technology. Equivalent CO_2 sensors that estimate concentrations based on measurements of other indoor pollutants are not recommended.

6. Portable CO_2 Monitors

Many CO_2 monitors are portable and capable of working from battery and electricity. Many can be powered just like a mobile phone from a USB cable connected to a laptop/PC or mains power adaptor. They do not have to be permanently fixed in place.

Electrical powered units are preferable to battery powered units as they are capable of providing pre-set, illuminated traffic-light style indication of indoor air quality feedback without the ongoing need to replace batteries.

Portable units are also preferable, as they will facilitate measurements in a wider range of locations.

7. Frequency of checking the accuracy of CO_2 readings

It is recommended to check the sensor response weekly by measuring the CO_2 concentration outdoors, where recorded values should be approximately between 400 and 480 ppm. Measurements in rooms should be made over a minimum of 1 hour, to allow the readings to reach a steady state and to collect a representative sample of data (AIVC, 2020). Short term/spot measurements are unreliable and should not be used to interpret ventilation performance.

Measurements taken over several days or weeks can enable occupants to become familiar with the impact of activities and outdoor weather conditions on ventilation and could be used to inform a strategy for improved ventilation.

8. Locating CO_2 monitors

Human exhaled breath contains high concentrations of CO_2 and measurements should therefore be made at least 0.5 metres away from people. Similarly, as outdoor air contains approximately 400 - 480 ppm of CO_2, indoor measurements should not be made near windows or ventilation grilles.

It is not recommended to use CO_2 measurements as an indicator of room/building ventilation when there are CO_2 sources present other than people, such as cooking and bunsen burners.

9. Safe CO_2 readings

In the context of SARS-CoV-2 transmission, CO_2 measurements are not a reliable proxy of risk to airborne exposure to the virus (SAGE, 2020). Both the AIVC and CIBSE advise that CO_2 concentrations above 1400 – 1500 ppm are likely to be indicative of poor ventilation (CIBSE, 2020, AIVC, 2021).

Where the ventilation is controlled by the occupant (for example, by opening windows in naturally ventilated rooms), CO_2 sensors can provide information to occupants to indicate poor ventilation.

10. Action to take if the CO_2 reading is above 1400-1500 ppm

Increase ventilation be opening doors and windows to address high CO_2 levels. The *Practical Steps for the Deployment of Good Ventilation Practices in Schools* provides guidance on how this should be achieved.

11. CO_2 readings in small and large rooms

In general the lower the reading the better the ventilation in the room. CO_2 measurements can be used to identify poorly ventilated multi-occupancy spaces.

CO_2 measurements are a less reliable measure of ventilation performance in single or low occupancy spaces or in very large spaces (SAGE UK, 2020, AIVC, 2021).

1. SAGE UK is a Scientific Advisory Group for Emergencies providing scientific and technical advice to support UK government decision makers during emergencies.

2. The Air infiltration and Ventilation Centre (AIVC) is the International Energy Agency's information centre on energy efficient ventilation.
3. CIBSE: Chartered Institute of Building Services Engineers