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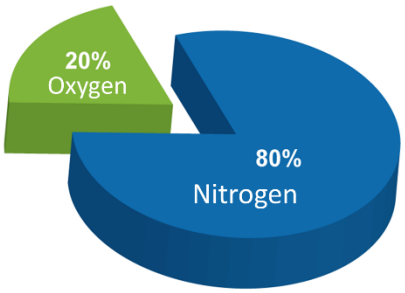
CO_2 LEVELS AND INDOOR AIR QUALITY



Our primary objective in measuring Carbon Dioxide (CO_2) is to assess the HVAC equipment operation to provide adequate ventilation per ASHRAE standards.

Outside air concentration is typically about 80% nitrogen, 20% oxygen, and less than 1% of other gasses. Other gases include argon, carbon dioxide, neon, helium, hydrogen, and others. Carbon dioxide is about 0.04% of outside air.

Why do we measure CO_2?

Outdoor concentrations of CO_2 can range from 350 to 500 parts per million (ppm) depending on the location and the time of year. In indoor environments, Carbon Dioxide is used as a tracer gas to quickly, but indirectly, assess approximately how much outdoor air is entering a room in relation to the number of occupants. CO_2 can be measured with relatively inexpensive real-time digital air monitoring equipment. CO_2 measurements have become a commonly used screening test of indoor air quality because levels can be used to evaluate the amount of ventilation and general comfort.

Outdoor "fresh" air ventilation is important because it can dilute contaminants that are produced in the indoor environment, such as odors released from people and contaminants released from the building, equipment, furnishings, and people's activities. Adequate ventilation can limit the buildup of these contaminants. It is these other contaminants and not usually CO_2 that may lead to indoor air quality problems, such as discomfort, odors "stuffiness" and possibly health symptoms.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has developed ventilation guidelines that should maintain a comfortable environment for most occupants. The amount of fresh air that should be supplied to a room depends on the type of facility and room. For example, in elementary school classrooms, ASHRAE recommends 15 cubic feet per minute person of outdoor air (for a 1000 square foot room occupied by 35 people).

These rates of ventilation should keep carbon dioxide concentrations below 1,000 ppm and create indoor air quality conditions that are acceptable to most individuals.

What levels of CO_2 are considered safe?

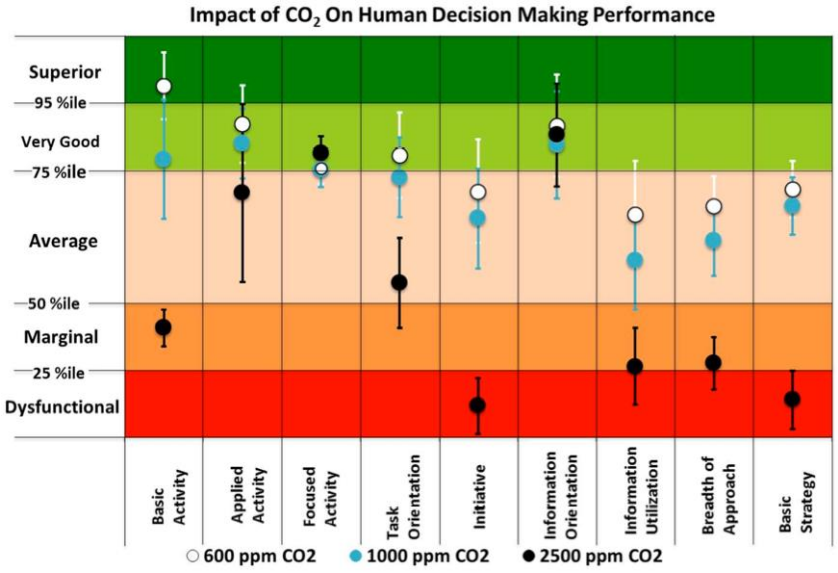
Carbon dioxide is not generally found at hazardous levels in indoor environments.

In Minnesota, the MNDOLI has set workplace safety standards of 10,000 ppm for an 8-hour period and 30,000 ppm for a 15-minute period. This means the average concentration over an 8-hour period should not exceed 10,000 ppm and the average concentration over a 15-minute period should not exceed 30,000 ppm. **It is unusual to find such continuously high levels indoors and extremely rare in non-industrial workplaces.**

Does CO_2 affect student performance?

In the classroom environment, the primary source of CO_2 is from the students and staff. Therefore, high levels of CO_2 are not expected in the indoor classroom environments.

There is a study that found a correlation of Cognitive Performance and CO_2 levels. In a study by the Lawrence Berkeley Laboratories of common indoor levels of CO_2, volunteers completed tests to evaluate their cognitive abilities. The evaluation found the following results showing a decrease in a number of categories with the greatest decline in Initiative, Basic Strategy, and Basic Activity when the CO_2 levels were at 2,500 ppm.



Sources: https://www.health.state.mn.us/communities/environment/air/toxins/co2.html

https://ehp.niehs.nih.gov/doi/full/10.1289/ehp.1104789