ASHRAE's New Position Document on Indoor Carbon Dioxide

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SUMMARY
Indoor CO_2 concentrations are often discussed in the context of ventilation and IAQ, most recently in relation to airborne infectious disease transmission. However, many applications of indoor CO_2 measurements do not reflect a sound technical understanding of the relationship between indoor CO_2 concentrations, ventilation and IAQ. ASHRAE has recently issued a Position Document that addresses the role of indoor CO_2 as a metric of IAQ and ventilation, the impacts of CO_2 on building occupants, the need for accurate indoor CO_2 concentration measurement, the use of CO_2 for controlling outdoor air intake, and how indoor CO_2 relates to airborne infectious disease transmission.

KEYWORDS: *Indoor CO_2, Guidance, IAQ metrics, Ventilation*

1 INTRODUCTION

Indoor CO_2 has been considered in the context of building ventilation and indoor air quality (IAQ) for centuries. Many of these discussions have focused on how CO_2 concentrations relate to occupant perception of human bioeffluents and the use of CO_2 to evaluate outdoor air ventilation rates. While these topics have been studied for decades, misinterpretation of CO_2 as an indicator of IAQ and ventilation still occurs. Recent research has examined the impacts of CO_2 on human cognitive performance at commonly observed indoor concentrations that were previously thought not to be of concern. Other recent studies have examined physiological impacts at these lower concentrations. Moreover, a variety of organizations and government bodies have issued standards and regulations for indoor CO_2 concentrations in workplaces, and CO_2 sensors have become less expensive and more widely deployed. Indoor CO_2 monitoring has also been promoted as a ventilation indicator in the context of managing the risks of airborne disease transmission. Most of these applications of indoor CO_2 require values for the rate at which building occupants generate CO_2, and the uncertainty of these rates has not been well characterized. These developments and longstanding issues regarding the application of indoor CO_2 concentrations motivated the development of the new ASHRAE Position Document.

2 CONTENT OF THE POSITION DOCUMENT

The full ASHRAE Position Document on Indoor Carbon Dioxide can be found at the following URL: https://www.ashrae.org/about/position-documents. The position document is much more detailed than this paper and contains complete references to all statements therein. The

document describes the motivations for its development and contains a background section that discusses the history of indoor CO_2 concentrations in the context of ventilation and IAQ, health and cognitive impacts of exposure to CO_2, existing standards and regulations for indoor CO_2 concentrations, CO_2 as an indicator of IAQ and ventilation, use of CO_2 as a tracer gas for estimating ventilation rates, increases in outdoor CO_2 concentrations, air cleaning directed at CO_2 removal alone, and CO_2 as an indicator of the risk of airborne disease transmission.

The Position Document states the following positions, paraphrased for this summary:

- Indoor CO_2 concentrations do not provide an overall indication of IAQ, but they can be a useful tool in IAQ assessments if users understand the limits in these applications.
- Existing evidence for impacts of CO_2 on health, well-being, learning outcomes and work performance at commonly observed indoor concentrations is inconsistent and does not currently justify changes to ventilation and IAQ standards, regulations, and guidelines.
- The use of indoor CO_2 measurements to assess and control the risk of airborne disease transmission must account for the definition of acceptable risk, space type and occupancy, and differences between CO_2 and infectious aerosols.
- Differences between indoor and outdoor CO_2 concentrations can be used to evaluate ventilation rates and air distribution using established tracer gas measurement methods, but accurate results require the validity of several assumptions and accurate input values.
- Sensor accuracy, location and calibration are all critical for drawing meaningful inferences from measured indoor CO_2 concentrations.
- Air cleaning technologies that remove only CO_2 will not necessarily improve overall IAQ and can interfere with systems using CO_2 for ventilation control or IAQ monitoring.

The Position Document recommends research in the following areas, paraphrased again:

- How CO_2 exposure modifies human responses to other environmental factors
- The development of IAQ metrics that cover the wide range of indoor contaminants
- Health and performance impacts of indoor CO_2 in concentration ranges typical of non-industrial indoor environments
- Physiological impacts of elevated CO_2 concentrations
- The relationship between indoor CO_2 and airborne infectious disease transmission
- Indoor CO2 concentration measurement including sensor performance and sensor locations for different applications
- The use of occupant-generated CO_2 as a tracer gas to estimate ventilation rates, including approaches that account for transient effects, multiple space systems and air distribution
- Strategies for demand control ventilation using CO_2 and other indicators of occupancy
- Surveys of indoor CO_2 concentrations, ventilation rates and occupancy for different building and system types to establish benchmark data and better understand the impacts of new building and system designs

The position document also recommends the development of guidance on indoor CO_2 measurement, the application of indoor CO_2 for demand control ventilation, ventilation measurement using CO_2 as a tracer gas and related topics.

4 CONCLUSIONS

This new ASHRAE position document helps to clarify the role of indoor CO_2 in the context of ventilation and IAQ and should be useful to practitioners, researchers and policymakers. As the recommendations for additional research and guidance are implemented, the information generated will further improve the application of indoor CO_2 concentrations in improving IAQ.