VAISALA / APPLICATION NOTE

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Technology selection essential for DCV savings

Optimizing demand controlled ventilation (DCV) will contribute to an enhanced indoor environment at lower operating costs. The system can only be optimized by accurate carbon dioxide (CO_2) sensing.

Humans spend 90 % of their time indoors. Studies indicate that indoor air quality (IAQ) is directly linked to human well-being and productivity. The CO_2 level can be used as an indicator for indoor human presense. A high CO_2 level is a sign of poor ventilation and often an indication of other unpleasant odors in the air. As many as 30 % of buildings have poor IAQ.

The most economical way to determine the ventilation demand is to measure carbon dioxide, which increases in relation to number of humans present. By controlling ventilation according to the CO_2 level rather than the assumed amount of people occupying the space, the indoor air can be kept fresh without over-ventilating and wasting energy.

Industry drivers

Limits for CO_2 levels in indoor air differ slightly from one country to another. For example, interpretation of ASHRAE (www.ashrae.org)Standard 62.1 “Ventilation for Acceptable Indoor Air Quality” implies CO_2 levels should not exceed 700 ppm above outdoor ambient levels of 400 ppm. The EU Commission has issued an Energy Performance in Buildings Directive (2002/91/EC) which specifies that energy savings should not have a negative impact on indoor air quality.

CO_2 Highlights Related to DCV

- Good indoor air quality can be achieved based on occupancy
- CO_2 measurement is the most economical method to monitor both air quality and human presence with one sensor
- Energy is saved by minimizing use of unconditioned outside air
- Inadequate ventilation results in an elevated CO_2 level, causing drowsiness and decreased productivity

CO_2 Information

- CO_2 is measured in parts per million (ppm)
- Typical outdoor ambient CO_2 concentrations: 350 – 450 ppm
- Acceptable IAQ CO_2 concentrations: 600 – 800 ppm
- Tolerable IAQ CO_2 concentrations: 1000 ppm

Energy savings as stated by the ETIAQ (Energy Technologies and Indoor Air Quality) project coordinated by Rehva, the Federation of European HVAC Associations, reports 20-50 % energy savings in public buildings using DCV, and even greater savings potential in buildings with varying occupancy.

Linking CO_2 performance to DCV systems

Green building initiatives, such as LEED (www.usgbc.org) Rating Systems, specify action to be taken when CO_2 conditions vary by 10% or more from the user specific set point. Either the building automation system will generate an automatic alarm and adjust the ventilation accordingly or an alert must be generated to the building occupants. The stability of the ventilation system is typically checked and adjusted only during commissioning. Once in place, CO_2 transmitters are expected to operate continuously for at least five years. Therefore, the selection of CO_2 technology is not only important for initial accuracy specifications, but for stability, too. Maintaining IAQ standards can be challenging while striving for energy efficiency.

Most CO_2 sensor manufacturers will offer an initial accuracy specification in the range of ±50 to 100 ppm at concentrations levels of 1000 ppm. If the system is set to maintain < 800 ppm CO_2 level in the space and the error of the sensor is 80 ppm, the deviation could lead to false alarms. If the CO_2 level indication is too low, it will be limiting the amount of fresh air. If the CO_2 level indication is too high, it will be introducing more unconditioned outdoor air to the space than is required. The situation is likely to worsen over time, if the sensor has poor long-term stability.

IAQ without false alarms

Every technology has some component that is depleting or changing, which makes it difficult to maintain the required accuracy specifications for the application. The most common technology on the market for measuring CO_2 is the non-dispersive infrared (NDIR) technology. The problems with this technology are the required light source that will lose its intensity over time and the inability to identify when contamination of the light path has occurred.

Vaisala's CARBOCAP® has a unique capability that measures at alternating dual-wavelengths: one wavelength to measure CO_2 and a second reference wavelength to determine the light source intensity and contaminant levels. The result is accuracy that lasts for years without having to rely on self-calibration techniques to perform a light source calibration.

One technology fits all HVAC applications

By eliminating the need for self-calibration, the Vaisala CARBOCAP® sensor can be used in a wider variety of applications including variable outdoor CO_2 levels or facilities with around-the-clock occupancy e.g. hospitals, workplaces, residential buildings, homes for the elderly.

Thanks to the robust CARBOCAP technology, the sensor in the duct-mount products is truly located in the duct. Other CARBOCAP® benefits include , tolerance to water condensation, and good temperature tolerance allowing use in refrigeration applications.

Visit Vaisala (www.vaisala.com/CO_2) to learn more about the complete CO_2 offering.

Guidelines for placing CO_2 transmitters

- Locations to avoid: locations where people may breathe directly on the sensor, near intake or exhaust ducts, near windows and doorways.
- Always prefer wall mount sensors to duct mount ones as they provide more accurate information on the effectiveness of the ventilation system.
- Locate wall mount sensors between 1 - 6 ft (0.3 – 1.8 m) above the floor.
- Duct mount sensors are suited for single zone systems and should be installed as close to the occupied space as possible, within easy access for maintenance.
- For multiple rooftop units, one CO_2 sensor per zone is recommended.
- For variable air volume (VAV) systems, one sensor per major zone is recommended.
- For common areas with multiple VAV boxes, a single CO_2 sensor is acceptable if the occupancy pattern is evenly distributed through out the common area.
- For a constant volume single rooftop unit serving multiple zones, one sensor per zone or space is recommended, with ventilation control based upon the highest CO_2 reading.

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For more information, visit www.vaisala.com or contact us at sales@vaisala.com

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