Beyond CO_2

VOC monitors help improve indoor air quality and reduce energy costs.

By: Thomas Aiken

Today's maintenance professionals are faced with a dilemma.

Poor indoor air quality (IAQ) can cause health problems for occupants, reduce productivity and create a negative impression of the facility.

One solution is to install indoor air quality monitors that signal fans to turn on only as needed.

Some of these systems function by monitoring the amount of carbon dioxide (CO_2) in the air.

Unfortunately, CO_2-based monitors can't detect the smell from a tuna sandwich left in a desk drawer over the weekend, or sweaty socks in a gymnasium locker or unpleasant odors in a restroom.

A better solution is an air quality monitor that can detect odors by sensing the presence of volatile organic compounds (VOCs).

By signaling fans to turn on when these compounds are present, and off when air quality returns to normal, VOC monitors reduce utility costs and optimize proper ventilation, thus ensuring the highest air quality.

The True Cost Of Poor Air Quality

Adults typically spend more than 80 percent of their day indoors, consuming about 15 kilograms of air per day.

If the quality of the air they breathe is poor, it can cause health problems.

According to the U.S. Environmental Protection Agency (EPA), immediate symptoms of exposure to polluted air can include throat irritation, dizziness and headaches.

Long-term health risks can include respiratory disease, heart disease and even cancer.

According to a U.S. White House Summit on Sustainable Buildings, students in schools with healthy air are more proficient at retaining information and teachers have fewer sick days.

For employers, improving indoor air quality directly correlates with higher productivity and a more satisfied workforce.

In fact, the Technical University of Denmark's International Centre for Indoor Environment and Energy reported that poor indoor air quality in buildings can decrease productivity by as much as six to nine percent.

While health and productivity are important, a malodorous room reflects poorly on the image of the facility.

A restaurant with great food and reasonable prices is bound to see a decrease in business if patrons lose their appetites after a visit to an unpleasant restroom.

Lingering cigarette smoke in hotel hallways and lobbies can drift into non-smoking rooms, irritating guests.

And while gym visitors come to sweat, they don't want to be overwhelmed by the odor of perspiration when they walk in the door.

IAQ Defined By Temperature, Humidity And Odor

The climate control industry defines the quality of indoor air as a measure of temperature, humidity and carbon dioxide.

For decades, the primary method for improving indoor air quality has been to dilute the amount of CO_2 and other contaminants through HVAC systems.

Unfortunately, as odors do not alter CO_2 levels, they're not detected by most indoor air quality monitors.

As air quality monitoring technology has become more sophisticated, it's now possible to detect the presence of VOCs, such as cooking odors, human bio-effluents, outdoor pollutants, paints and lacquers, cleaning supplies and toxins.

FIGURE 1

Examples Of VOCs And Sources

Substance Group	Example	Sources
Alcohols	alcohol, mineral spirits	cleaning supplies
Aldehydes	formaldehyde	building materials
Ketones	butanone	paints
Esters	methyl acetate	glues
Terpenes	pinene	glues
Aromatics	xylol	paints and glues
Alkanes	heptane	human breath

Figure 1 shows the sources of the most common chemical groups of mixed gases found in indoor air.

These gases can be released into a facility's air from building materials, furnishings, office equipment and adhesives.

According to the EPA, VOCs are two to five times more likely to be found inside enclosed environments than outside.

VOC-based air quality monitors optimize proper ventilation to ensure the highest air quality.

FIGURE 2

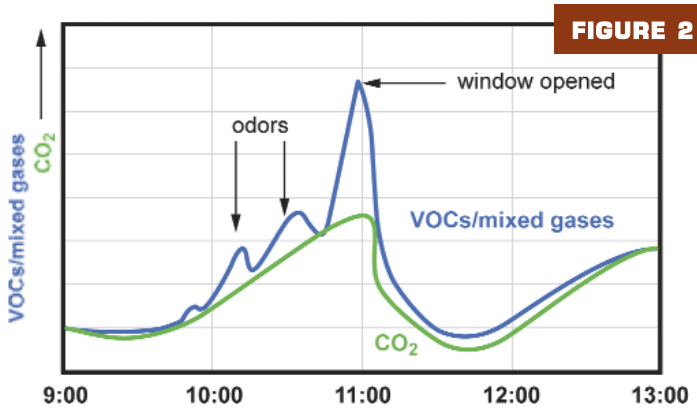

FIGURE 3

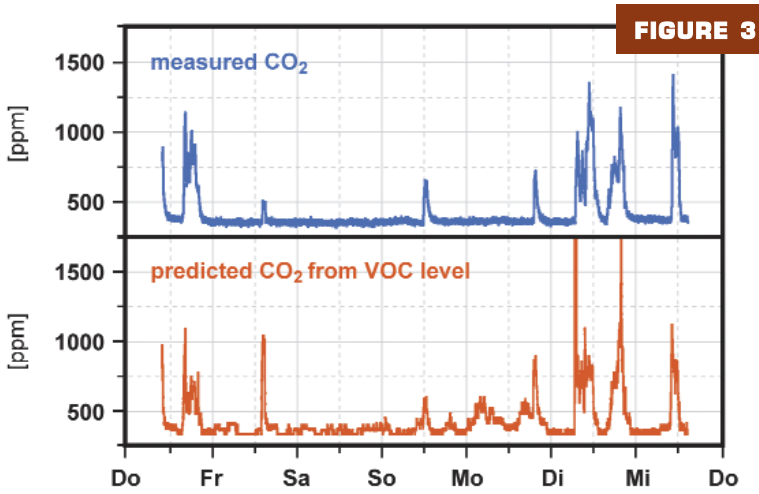

FIGURE 4

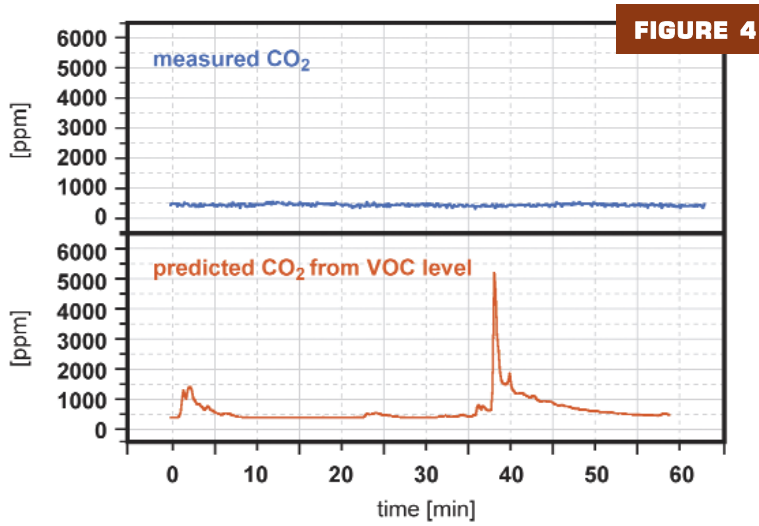

Figure 2 illustrates the correlation of CO_2 and the concentration of mixed gases measured in a typical conference room.

The figure illustrates the increasing CO_2 level and additional odorous events rather than just the exhaled CO_2 from the conference room's occupants.

Reduce Energy Cost While Improving Air

VOC monitors can also include features such as low power consumption, the ability to operate in harsh environments and maintenance-free sensing elements.

In addition, they can reduce utility costs by alerting climate control systems to increase airflow only when the threshold levels for target gases are exceeded.

In the following example, a VOC monitor was installed in a gymnasium's HVAC system to monitor air quality and control fan speed.

Figure 3 compares the data collected from the gym, confirming that the concentrations of predicted and measured CO_2 were consistent.

Before the VOC monitor was installed, the HVAC system was time-controlled, so the gymnasium was ventilated even when it was unoccupied.

By switching to demand-controlled ventilation, the VOC sensor reduced operating time by 24 percent and cut energy consumption by 60 percent.

In addition to cost savings, in post-installation surveys, visitors to the gym gave the air quality good ratings.

Another example of the effectiveness of VOC monitors is in a room notorious for unpleasant odors — the commercial restroom.

Figure 4 compares the measured CO_2 to the predicted CO_2 from VOC levels in a restroom.

The cause of most restroom odors is the presence of a large amount of human bioeffluents — mainly methane and hydrogen.

At peak concentrations, these compounds correspond to more than 5,000 parts per million (PPM) of predicted CO_2.

VOC Monitors Enhance Building's Sustainability

While today's maintenance professionals are diligent about reducing energy costs and utilizing sustainable materials, they often overlook the quality of the facility's indoor air.

Considering that contaminated air poses health risks to occupants, lowers productivity and comfort and reflects poorly on the facility, HVAC suppliers are being asked to provide indoor air quality monitors capable of detecting the presence of VOCs.

As VOC monitors lower utility costs and improve green building initiatives, they are bound to become even more prevalent in the near future. *CM*

Thomas Aiken is CEO of AppliedSensor Inc., a Warren, New Jersey-based company providing microelectronic chemical sensor systems. Previously, he held executive positions at Fisher Scientific, Sigma-Aldrich, Exxon and Ralston Purina. Aiken has a B.S. in Physiology and in Animal Science from the University of Illinois and an MBA in Finance and Marketing from Washington University.