BAPI VOC Sensor Offers an Alternative to CO_2 for Demand Controlled Ventilation

Most system designers use CO_2 sensors to indicate room occupancy as part of their Demand Controlled Ventilation (DCV) setup. One drawback with this method is that it ignores the harmful contaminants that may be present in the air even when the CO_2 levels are low.

BAPI's VOC Sensor offers the best of both worlds. It allows for ventilation based on occupancy as well as air contaminants -- and doesn't require any more work than using a CO_2 sensor.

The BAPI unit does this by measuring Volatile Organic Compounds (VOCs) then outputing a signal that corresponds to a CO_2 level of 0-2,000 ppm. This means system designers can use their existing CO_2-based DCV occupancy algorithms while monitoring both occupancy and VOCs.

One of the keys to the BAPI sensor is the fact that VOCs are as good an indicator of space occupancy as CO_2. That's because a large share of VOCs in an indoor space are generated by humans from our breath, sweat and skin or from colognes and perfumes, etc. (See Table 1.)

Extensive research was conducted on human occupancy, VOC levels and CO_2 levels in 1,500 offices, schools and homes to determine the relationship between these three factors. The research identified a complex correlation algorithm between VOCs and CO_2, and this algorithm was used to create the output of the VOC sensor. The accuracy of this output as compared to CO_2 levels is shown in the chart at right.

The chart shows that the VOC sensor tracks occupancy and that the output has a high correlation to the CO_2 level. The chart also shows that the sensor indicates when additional VOCs or air contaminants are present from cooking or other activities.

More information on the BAPI VOC Sensor including a White Paper and Video are available on our website at ***www.bapihvac.com***

Table 1 – Typical Indoor Contaminants (VOCs) and Their Source

Contamination Source	Emission Source	VOC
Human Being	Breath	Acetone, Ethanol, Isoprene, CO_2
	Skin Respiration & Perspiration	Nonanal, Decanal, alpha-Pinene
	Flatulence	Methane, Hydrogen,
	Cosmetics	Limonene, Eucalyptol
Consumer Products	Household Supplies	Alcohols, Esters, Limonene
Office Equipment	Printers, Copiers, Computers	Benzene, Styrene, Phonole
Combustion	Engines, Appliances, Smoke	Unburnt Hydrocarbons, CO, CO_2
Building Materials	Paints, Adhesives, Carpets	Formaldehyde, Alkanes, Alcohols, Aldehydes, Ketones
Furniture	**P**oly **V**inyl **C**hloride (PVC)	Toluene, Xylene, Decane

Indicating Occupancy with VOCs

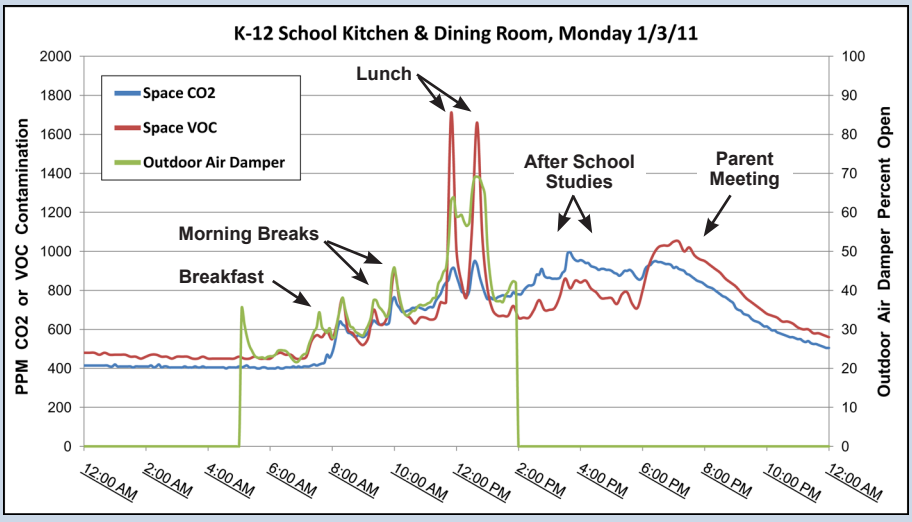
This chart was taken in a kitchen and dining area of a public school in Wisconsin. This is a true multi-purpose area with breakfast, snacks, lunch, and after school studies in the day, and athletic practices, exercise classes and meetings at night.

The open percentage of the outdoor air damper is controlled by the VOC sensor output through a PID control loop from 5 am to 2 pm when the space is considered "occupied". The outside air damper is closed during the unoccupied period, and ventilation is accomplished by diffusion from the adjacent hallways.

At 7 am, the VOC sensor picks up the breakfast cooking aromas and activities. The CO_2 sensor climbs a short time later as the students arrive to eat. The VOC sensor has slightly higher readings than the CO_2 sensor during breakfast and the morning breaks because the VOCs from the food are added to the VOCs generated by the people. This is also seen at lunch as cooking of the sausage pizza generated lots of VOCs which are added to the VOCs from the students and staff. The BAPI sensor will allow these additional VOCs to be ventilated away while the CO_2 sensor will not.

At 2:30 pm, students arrive for "After School Studies" so the VOCs and CO_2 rise a little during this period. There is a community meeting at 6 pm. Notice how the VOCs track slightly below the CO_2 during the "After School Study" period when it is mostly kids in the room. Then the VOCs track slightly above the CO_2 during the community meeting period when it is mostly adults in the room. This is because adults use more perfumes and colognes than kids, and therefore generate more VOCs than kids.

Whether it's kids or adults in the room, and whether they're studying or eating, the chart proves that the VOC sensor output directly correlates to occupancy in the room and can easily be set up for Demand Controlled Ventilation.



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