General information on indoor air quality and the measurement of VOC and CO2

Various MultiSensors (e.g. MultiSensor-TI) are equipped with special sensors for measuring air quality and various gases. This article will take a closer look at the general topic of assessing indoor air quality.

We spend around 80 percent of our time indoors. For us to feel comfortable and be able to work productively, the air quality in these rooms must be right.

Air quality has a direct impact on people: In schools with good air quality, pupils perform better and teachers have fewer sick days. For employees, air quality has a direct impact on productivity and satisfaction.
Rooms must be ventilated to ensure good air quality.
Ideally, the air contains 21 percent oxygen and 79 percent nitrogen. But of course there are always other components, including noble gases, carbon monoxide (CO), carbon dioxide (CO2) and volatile organic compounds (VOCs).
VOCs are different types of hydrocarbons that originate mainly from biological sources (e.g. humans) and from building materials or appliances. There are between 5,000 and 10,000 different VOCs. The table shows some examples together with their origin. VOCs cause eye irritation, headaches, dizziness or even nausea.

However, the influence of bad air on humans is commonly attributed to CO2. However, experiments, including on the ISS, show that the impact of CO2 on humans is comparatively small. Even concentrations of 10,000 ppm have no effect on our well-being. Concentrations of this magnitude are not reached even if several people stay in one room for hours.

Nevertheless, CO2 concentration has mainly been measured to determine air quality and to control ventilation systems, as CO2 sensors are much easier and cheaper to manufacture than VOC sensors. This is not entirely wrong, as the CO2 concentration in the air is on average proportional to the concentration of man-made VOCs. However, the dynamic behavior of humans leads to exceptions: Activity or excitement lead to a sudden increase in VOC concentrations, as does the use of perfumes or cleaning agents. These effects are not reflected in the CO2 concentration, and a VOC sensor can be used to react flexibly to human influences and only operate the ventilation when it is really necessary. What remains are the influences of building materials and furniture, especially in new buildings or after the purchase of new furniture. Normally, it is sufficient to operate the ventilation constantly at 5 to 10 % of maximum output to keep these VOCs low, and most people have no idea what a VOC sensor measures. This is why the limit values were regulated in the iAQ index (intelligent Air Quality). This means that suitable measures, such as staged room ventilation, can be implemented on the basis of threshold values.

Various substances that influence air quality and their origin

	Origin	Substance
Human	Breathing	Acetone, ethanol, isoprene, CO2, water
	Skin respiration and transpiration	Nonanal, decanal, alpha-pinene, water
	Flatus	Methane, hydrogen
	Cosmetics	Limonene, eucalyptol
Combustion	Motors, cigarettes, …	CO, CO2, water
Building materials, furniture, appliances	Solvents, paints, varnishes,…	Formaldehyde, alkanes, alcohols, carbonyls, ketones, siloxanes
	PVC	Toluene, xylene, decane
	Printer/copier	Benzene, styrene, phenols

The following table shows the different levels of air quality rated according to your Indoor Air Quality Index (IAQ)

IAQ Index	Air quality	Effects (long-term exposure)	Proposed measure
0 – 50	Excellent	Clean air; the best for the well-being	No measures required
51 – 100	Good	No irritation or effects on well-being	No measures required
101 – 150	Lightly soiled	Reduction of the well-being possible	Ventilation proposed
151 – 200	Moderately dirty	Clearer irritation possible	Increase ventilation with clean air
201 – 250	Heavily soiled	Depending on the type of VOCs, exposure can lead to effects such as headaches	Improve ventilation
> 250	Very heavily soiled	More serious health problems possible if harmful VOCs are present	Contamination should be identified when level is reached even without people present; maximize ventilation & reduce presence