VOC Sensors

What are VOCs

VOC is an abbreviation for Volatile Organic Compounds and a collective term for gaseous carbonaceous substances. Depending on how high the concentration of these substances in the ambient air is, we can perceive them by smelling them with our nose. On average, a person inhales about 15 kg of air per day, 80% of it indoors. Outside air quality is routinely monitored by public agencies. Indoor air quality is the responsibility of the operators or occupants of the respective building.

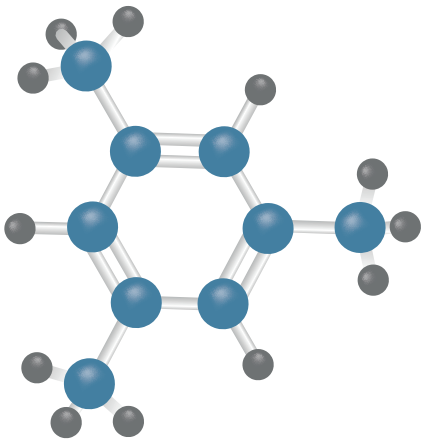
VOC Sources

In buildings there are numerous sources of VOC, for example:

- Human metabolism (methane)
- Perfume
- Hairspray
- Paint
- Floor coverings
- Adhesives
- Printers
- Furniture
- Tobacco
- Cleaning agents

Health implications

Volatile organic compounds have an impact above all on the well-being of humans. Even low concentrations can cause irritation to mucous membranes (eyes, nose and respiratory tract) as well as headaches, fatigue and nausea. At high concentrations and with certain compounds this may even be harmful to health. For most chemical compounds, local authorities have set maximum values for VOC concentrations in workplaces.



Xylene (chemical compound)

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VOC Gases

The following gases can be detected with Belimo sensors:

Chemical compound	Formula
Isobutane	C_4H_{10}
Carbon monoxide	CO
Carbon dioxide	CO_2
Methane	CH_4
Hydrogen	H_2
Ethanol	C_2H_6O
Ethane	C_2H_6
Propane	C_3H_8
n-Hexane	C_6H_{14}
n-Heptane	C_7H_{16}
n-Octane	C_8H_{18}
n-Decane	$C_{10}H_{22}$
Undecane	$C_{11}H_{24}$
Ethene	C_2H_4
Benzene	C_6H_6
Toluene	C_7H_8
Xylene	C_8H_{10}
Methanol	CH_4O
Isopropyl alcohol	C_3H_8O
1-Pentanol	$C_5H_{12}O$

Chemical compound	Formula
Acetone	C_3H_6O
Ethylene oxide	C_2H_4O
Formaldehyde	H_2CO
Acetaldehyde / ethanal	C_2H_4O
Glutaraldehyde	$C_5H_8O_2$
Acetic acid	$C_2H_4O_2$
Propanoic acid / Propionic acid	$C_3H_6O_2$
Butanoic acid / Butyric acid	$C_4H_8O_2$
Pentanoic acid / Valeric acid	$C_5H_{10}O_2$
Ammonia	NH_3
Hydrogen sulphide	H_2S
Methanethiol	CH_4S
Dimethyl disulphide	$C_2H_6S_2$
Nitrogen monoxide	NO
Nitrogen dioxide	NO_2
Sulphur dioxide	SO_2
Triethylamine	$C_6H_{15}N$
R-22	$CHClF_2$
R-134a	$C_2H_6F_4$
R-12	CCl_2F_2

Measuring range

Today, metal oxide semiconductor sensors are almost exclusively used as VOC sensors in heating, ventilation and air-conditioning technology. This sensor element measures the conductivity of the nanocrystalline metal oxide that is applied to a substrate. These sensors only permit the measurement of a relative gas concentration. As a result, it is not possible to specify a measuring range or accuracy. This is due to the following reasons:

Gas-dependent sensitivity

Different gases can occur in one and the same room (e.g. from people, building materials or furniture), to which the sensor reacts with differing levels of sensitivity. In addition, the sensitivity for one gas can also be affected by the presence of another gas (cross-sensitivity). Therefore, a single gas cannot be clearly identified.

Stability

VOC sensors are not stable in the long term and drift after some time. Most VOC sensors compensate for this by evaluating the lowest measuring value over a period of time as "clean air" and then correcting the zero point if necessary (baseline correction).

Sample control

VOC sensors are not calibrated during manufacturing. As a result, even sensors of the same type may exhibit different behaviour.

MOX VOC sensors can be compared to the human nose, which also reacts with differing sensitivity to different gases, but very reliably detects rapid changes in gas concentration.

Applications

VOC sensors are necessary wherever unpleasant odours may occur. The VOC sensor detects how much outdoor air must be supplied. The devices are not suitable for safety solutions, such as gas alarms, smoke alarms or activated carbon filter monitoring!
Since the sensors are not selective, they cannot distinguish between good and bad smells. As a result, they are not the right tool for saving energy in on-demand ventilation systems (e.g. in office spaces). However, they can be very effective in applications where expected odours are to be contained (e.g. smoker lounges, hookah bars, kitchens, toilets).

Commissioning

Commissioning VOC sensors involves a greater effort. Possible procedure:

1. Set the VOC setpoint to 50%
2. Assess the air quality and actual volumetric flow over several days
3. Optimise
   a) Poor air quality and low fan speed
   – Decrease the VOC setpoint by 25% (50% to 37.5%)
   – More ventilation
   b) Good air quality and high fan speed
   – Increase the VOC setpoint by 25% (50% to 62.5%)
   – Less ventilation
4. Return to step 2 and then adjust upward or downward. Track changes and results using a list to narrow down the optimal setpoint

VOC in combination with CO_2

Belimo only offers VOC sensors in combination with a CO_2 sensor element. This is because only the CO_2 sensor can reliably detect the occupancy of a room. In addition, the CO_2 sensor exhibits a more stable measurement behaviour and less drift. Supplementary to the CO_2 sensor, the VOC sensor detects unpleasant odours. As soon as the set limit values are exceeded, the sensors initiate the necessary air exchange, so that the pleasant feeling of fresh air is ensured. The mix signal, which is the output on some devices, calculates the measuring values from the VOC and CO_2 sensor elements for a combined air quality measurement result. This simplifies integration of the sensor into the management system. Compared to only a VOC sensor, combining the two measuring signals can save energy.

Overview of Belimo VOC sensors

Type	Measuring range VOC	Application	Output signals	Measured fluids
22DCV-11	0...100%	Duct	DC 0...5 V / 0...10 V	VOC, CO_2
22DCM-11	0...100%	Duct	DC 0...5 V / 0...10 V	VOC, CO_2, temperature
22DCK-11	0...100%	Duct	DC 0...5 V / 0...10 V	VOC, CO_2, temperature, mix CO_2 + VOC

All inclusive.

As a global market leader, Belimo develops innovative solutions for the regulation and control of heating, ventilation and air-conditioning systems. In doing so, actuators, valves, and sensors make up the core business.

With a consistent focus on customer value, we deliver more than just products. We offer you the complete product range of actuator and sensor solutions for the regulation and control of HVAC systems from a single source. At the same time, we rely on tested Swiss quality with a 5-year guarantee. Our worldwide representatives in over 80 countries guarantee short delivery times and extensive support through the entire product life. Belimo does indeed include everything.

"Small" Belimo products have a major impact on comfort, energy efficiency, safety, installation, and maintenance. In short: small devices, big impact.

- 5-year guarantee
- On site around the globe
- Complete product range
- Tested quality
- Short delivery times
- Comprehensive support

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