

APPLICATION NOTE

Rapid and reliable chamber testing of formaldehyde emissions from paint



“Compared to the current reference method, the main advantage of the GASERA ONE FORMALDEHYDE is that measurements and data processing can be performed much faster with no sample preparation”

- Leea Kuusimäki, Researcher, Tikkurila

Application

At room temperature, formaldehyde is a colorless, flammable gas with a strong odor. Exposure to formaldehyde may cause irritation of the skin, eyes, nose, and throat, and high levels of exposure may cause cancer. Formaldehyde can be found for example in resins, wood products, building and insulation materials, glues, coatings, and paints.¹

Tikkurila does not actively add formaldehyde to its paints, but traces of formaldehyde can be present due to decomposition of certain individual raw materials used in some paint formulations. In acid-catalyzed industrial coatings, formaldehyde is released due to chemical reactions in the drying process. In these products, the emissions typically decrease under the European Standard EN 13986 for E1 classification limit value of 0,124 mg/m³ within 28 days.

A leading Nordic paint company Tikkurila, currently part of PPG, follows the M1 protocol when testing its products. The M1 sets limits for the emission levels of VOC's, formaldehyde, and ammonia.² Tikkurila tests its new and modified interior decorative paints for VOC and formaldehyde emissions before sending samples to an independent accredited laboratory that analyzes the products according to the M1, ISO 16000-3 and EN 16516.³

Technology

The GASERA ONE FORMALDEHYDE gas monitor enables selective real-time measurements of formaldehyde. It is based on combining the ultra-sensitive cantilever enhanced photoacoustic detection technology with a Quantum Cascade Laser (QCL) source operating at a Mid-IR fundamental spectral absorption line for formaldehyde.



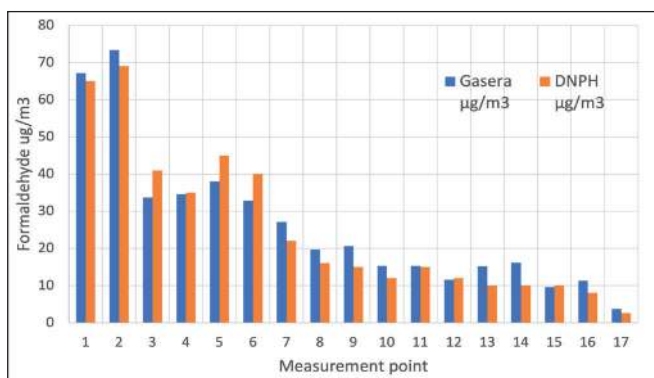
Figure 1. GASERA ONE FORMALDEHYDE in action

A major advantage of the photoacoustic technology is that the sensitivity of the measurement is not dependent on the absorption path length. This enables high sensitivity with a short absorption path, and a highly linear response over a wide dynamic measurement range, all with very low sample

volumes (typically only a few milliliters). The monitor provides enough sensitivity to reliably measure ambient background levels of formaldehyde in real-time and does not require any consumables. It also gives an exceptionally high level of stability with a recommended re-calibration period of 12 months. Thus, the total cost of ownership is low.

Measurements

Tikkurila compared two measurement techniques: the DNPH cartridge method (ISO 16000-3), and direct measurement using the GASERA ONE FORMALDEHYDE to quantify formaldehyde emissions. An acid-catalyzed industrial product in a stainless-steel chamber was used as a source of formaldehyde in the comparison of methods in most of the measurements. This product category was chosen for these first method comparison tests to have more distribution in concentration range. Typically, in interior decorative paints the concentrations are below this range. Some measurement points are comparisons with interior paints; in these measurements background is not subtracted. Graph 1 shows that measurement results obtained with the GASERA ONE FORMALDEHYDE and the reference method, DNPH, are closely aligned below the level of $70 \mu\text{g}/\text{m}^3$. In these measurements, the measured concentration range was from $70 \mu\text{g}/\text{m}^3$ (57 ppb) to $6 \mu\text{g}/\text{m}^3$ (4 ppb). Also, background measurements of empty chambers with the GASERA ONE FORMALDEHYDE using multiple data points show good repeatability, measured background levels being $2\text{--}8 \mu\text{g}/\text{m}^3$. The GASERA ONE FORMALDEHYDE gives an easy and convenient way to monitor this kind of emission measurement.



Graph 1. A comparison of measurement results obtained with the GASERA ONE FORMALDEHYDE and the DNPH reference method

- <https://www.epa.gov/formaldehyde/facts-about-formaldehyde>
- <https://cer.rts.fi/en/m1-emission-class-for-building-material/what-is-m1>
- <https://www.iso.org/obp/ui/#iso:std:iso:15234:ed-1:v1:en>

Sampling with the GASERA ONE FORMALDEHYDE does not disturb the equilibrium of the sample chamber as it draws only around 50 milliliters of sample per measurement cycle when using the standard sampling settings. Also, the analyzer can be used in a closed loop setting with the chamber as the sample is not consumed during the measurement. In comparison, DNPH sampling takes at minimum 15–20 liters of chamber air and optimizing the sample amount is always a tradeoff between the best accuracy and the least interference to the chamber.

Conclusions

Leea Kuusimäki, a researcher at Tikkurila, sees several benefits in using the GASERA ONE FORMALDEHYDE for measuring formaldehyde emissions from paint: “Not only can the measurements be performed much faster with lower sampling volumes and without sample preparation, but the results are also reliable due to multiple data points per sample because of real-time measurement and very good sensitivity”. In addition, formaldehyde monitoring with the GASERA ONE FORMALDEHYDE requires no consumables and no maintenance of the laboratory equipment. The GASERA ONE FORMALDEHYDE can also be used along with the GASERA 12-input Multipoint Sampler to enable automatic formaldehyde monitoring from up to 12 locations.

GASERA ONE FORMALDEHYDE

- High sensitivity enabling the measurement of very low formaldehyde concentrations, LoD < 1 ppb @ 60 s
- Dynamic range: Over 5 orders of magnitude (i.e. 100 000 times the detection limit)
- Precision/Repeatability: Less than 1 % of measured value in operational conditions at the calibration concentration
- Ease of use
- No consumables, long time between calibrations
- Temperature and pressure stability: changes in ambient temperature or pressure will not cause drift