

European Metrology
Programme for Innovation
and Research

Delivering Impact



FORMALDEHYDE



Ensuring compliance to present and future legislation of formaldehyde levels

Industrial processes and the burning of wood or fossil fuels release formaldehyde into the atmosphere. Many common household products also release this gas, which can build up in enclosed environments, causing respiratory distress and cancers. In 2026, new limitations on products which emit formaldehyde come into effect and for industry to demonstrate conformity requires accurate, validated monitors for this ubiquitous pollutant.

Europe's National Measurement Institutes working together

The European Metrology Programme for Innovation and Research (EMPIR) has been developed as part of Horizon 2020, the EU Framework Programme for Research and Innovation. EMPIR funding is drawn from 28 participating EURAMET member states to support collaborative research between Measurement Institutes, academia and industry both within and outside Europe to address key metrology challenges and ensure that measurement science meets the future.

Challenge

Formaldehyde, also known as methanal, is a colourless, volatile organic compound released from burning wood, tobacco smoke and from paints, varnishes, adhesive, and waxes. Low levels of formaldehyde in the air are considered harmless, but levels can build up to ten times higher indoors compared to the outside. As citizens in developed countries spend around 90% of their time inside buildings, formaldehyde is classified as a key indoor pollutant. As well as being linked to asthma and respiratory distress, it is also classified as a carcinogen by the International Agency for Research on Cancer (IARC).

The EU directive 2004/37/EC on the protection of workers from exposure to carcinogens, mutagens, and toxic substances sets formaldehyde's permissible indoor level at 0.37 mg/m³. In 2023, a new regulation was introduced that set much tighter limits (EU 2023/1464) to come into force in 2026. This specifies that producers cannot place products classed as formaldehyde releasers on the market if these emit more than 0.062 mg/m³ of it from wood-based articles and furniture or 0.08 mg/m³ for textiles, leather, plastics, and electronic products.

For producers to ensure compliance to the new directive, it is essential that formaldehyde monitors be able to accurately measure these lower levels.

Solution

During the [MetClimVOC](#) project, an intercomparison was organised by IMT Nord Europe, one of the 6 units of CiGas within the research infrastructure ACTRIS. Ten different formaldehyde analysers based on seven different measurement techniques were compared, including instruments based on infra-red spectroscopy, proton-transfer-reaction mass spectrometry and Cavity Ring-Down Spectroscopy (CRDS). Four instruments were based on the Hantzsch method (where formaldehyde is converted to a fluorescent form which is then measured) including the microF, a microfluidic based instrument from the company Chromatotec. Analysers were evaluated for repeatability, limit of detection, linearity, and drift, and compared to a reference technique used by regulatory networks in Europe and the USA which binds formaldehyde to 2,4-dinitrophenylhydrazine (DNPH) on filters which are measured offline.

Results indicated that the DNPH, CRDS and Hantzsch-fluorimetry instruments were the most robust, with the microF able to quantify formaldehyde down to few nmol/mol with a measurement uncertainty of 13%, which could be further reduced with improved calibration techniques.

Impact

For 40 years Chromatotec has specialised in the design and manufacturing of automated gas analysers to industry and environmental services, providing instruments for measuring over 300 different molecules with the company's proprietary technology.

Based upon the intercomparison results the company further improved their microF instrument. To reduce the measurement uncertainty due to external calibration, an internal source of formaldehyde was integrated into the microF using Chromatotec's certified permeation technology. In recognition that users are not environment or technical experts, measurements were also simplified by the addition of a "data generator" for ease of use. At the end of the project Chromatotec worked with an ACTRIS National Facility in France the Puy de Dôme Observatory, and CiGas IMT Nord Europe, in the framework of ATMO-ACCESS project, to further validate its performance. Using microfluidics to minimise reagent use, the

compact microF can continuously monitor levels of formaldehyde in indoor air in real-time. With a lower detection limit of 0.0003 mg/m³ and a measurement uncertainty < 10% this is well below the formaldehyde restriction of 0.062 mg/m³ for furniture and textiles in the 2023 regulation.

The work performed in MetClimVOC will allow improved measurements for this toxic gas, allowing industry to demonstrate conformance to current and future regulations. Environmental agencies will also be better placed to assess formaldehyde levels – both indoors and outdoors – ensuring the safety of both European citizens and the environment.

Providing SI-traceability for volatile organic compounds

The MetClimVOC project:

- Determined a priority list of oxygenated VOCs, terpenes and halogenated VOCs. Except for the latter, the listed VOCs were incorporated into the Air Quality Directive (EU) 2024/2881.
- Produced first SI-traceable reference gas mixtures for oxy-VOCs acetone, ethanol, butanone and methacrolein at low amount fractions (< 100 nmol/mol) with a temporal stability up to 18 months.
- Developed four protocols for generating SI-traceable working standards for oxy-VOCs, two for terpenes and one for halogenated VOCs.
- Developed an on-line tool to simplify uncertainty budget calculations for the atmospheric monitoring community.
- Investigated effects of line material, particle filters, water removal, ozone scrubbers and sorbent tubes on sampling.
- Developed a methanol analyser and contributed to the development of new SI-traceable reference material for Proton-Transfer-Reaction Mass Spectrometry.
- Obtained SI-traceable spectral parameters for tetrafluoromethane, sulfur hexafluoride and fluoroform to be provided to HITRAN, a database to predict and simulate the transmission and emission of light in the atmosphere.

The improved and harmonised data will allow better mitigation strategies aimed at decreasing the health and environmental burden related to air pollution and climate change.



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