

Benchmarks for managing indoor air quality – formaldehyde

Executive summary

Formaldehyde (FOR) is a gas which causes irritation of the airways and ocular mucous membranes. In 2004, the International Agency for Research on Cancer classified it as carcinogenic to humans (Group 1), based on an excessively high number of nasopharyngeal cancer cases observed after occupational exposure. Formaldehyde, which is genotoxic, is characterised by high reactivity with the biological tissues at the contact site, and this explains why it does not enter the bloodstream in any significant amounts.

It is a substance commonly found in enclosed spaces. The main sources of emission are construction, decoration and furnishing products (especially particleboards), household products (cleaning products, paint, varnish, glue and cosmetics for example) and combustion activity in all its forms: cookers, boilers, ornamental fireplaces and smoking or burning incense. Outdoor air generally contributes very little to indoor concentrations.

Human exposure mainly occurs by inhalation. The contribution of indoor air predominates in the population's overall exposure owing to the time spent indoors and the low outdoor values typically measured. All of the data available in France shows that, irrespective of the type of building (housing, offices or public venues), the average concentration levels in enclosed spaces are generally in the range of 20 $\mu\text{g}/\text{m}^3$. The kinetics of FOR concentrations nevertheless reveal considerable variability in indoor air levels, which can result in exposure exceeding 100 $\mu\text{g}/\text{m}^3$ over more than one hour.

For the purposes of monitoring indoor air quality in establishments open to the public, the French regulations set certain indoor air quality benchmarks. Applicable since 1 January 2015, the IARV for formaldehyde is set for long-term exposure (> 1 year) at **30 $\mu\text{g}/\text{m}^3$** and should be brought down to **10 $\mu\text{g}/\text{m}^3$** as of 1 January 2023.

Given the knowledge available at the time its last report on FOR was written (February 2018) and international practices for establishing toxicity reference values (TRVs), the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) now proposes a new single indoor air quality guideline (IAQG) for short-term exposure (assessed over a period of 1 to 4 hours) of **100 $\mu\text{g}/\text{m}^3$** to protect the general population from both acute and chronic effects of FOR exposure. This is because the risk of cancer is considered to result from repeated inflammatory processes triggered, over the long term, by bouts of possibly short-term exposure. Consistent with the guideline proposed by the World Health Organisation (WHO) in 2010, this IAQG must be complied with at all times. Ideally, continuous assessment of FOR concentrations should therefore be possible to ensure that this IAQG is never exceeded.

Grounded strictly in health criteria, this guideline does not provide information on "action guidelines", i.e. concentration levels above which action is required to protect people's health.

This is why the General Directorate for Health (DGS) and General Directorate for Risk Prevention (DGPR) have asked the French High Council for Public Health (HCSP) to establish "benchmarks" for setting the maximum levels in new or renovated buildings and, where necessary, for taking corrective action in establishments open to the public, with such action and its implementation time-limit being adjusted in light of the concentration levels measured.

In the context of this referral, the HCSP began by updating its framework document written in 2009, setting out the common principles guiding establishment of these benchmarks, called "benchmarks for managing indoor air quality". The present document corresponds to application of this methodological framework to formaldehyde.

After factoring in the critical effect selected by ANSES for setting its IAQG (ocular irritation), considering the population's average exposure levels in the various enclosed spaces and the reported kinetics of FOR in the documents available, and considering the regulatory provisions currently governing FOR and the measurement methods currently available, the HCSP recommends adopting two benchmarks for management where formaldehyde is concerned:

- An **indoor air quality benchmark (IAQB)** set at **100 µg/m³** (measurements carried out over successive 1 to 4-hour periods, throughout the day, when the building is occupied).

The HCSP recommends that this IAQB of 100 µg/m³ become immediately applicable and complied with in all buildings, with a maximum delay for taking corrective action of 6 months.

This 6-month delay takes account of the normal requirements associated with performing certain types of work: conducting assessments and surveys, time-limits associated with public procurement, requests for attribution of specific budgets, schedule to be coordinated with the activities of certain establishments and so on. That said, all reasonably feasible measures for reducing exposure of the population (not least the most sensitive groups, such as children or people suffering from respiratory diseases) should be rolled out as swiftly as possible. Examples: enhanced manual airing, installation of additional mechanical ventilation systems, identification of the main emission sources, reorganisation of certain activities, redistribution of people in the building based on the rooms available, etc.

To ensure compliance with the IAQB, measurements must be taken by active sampling at 1- to 4-hourly intervals.

Accordingly, in the specific case of formaldehyde, and owing to its mode of action, the IAQB and IAQG are similar and measured over short time intervals.

- A **provisional management value** set at **30 µg/m³** (measurements over a 4.5- to 7-day period).

In order to limit the number, and therefore the cost, of measurements to be taken, given the measuring instruments currently standardised and considering the monitoring studies and different documents analysed, the HCSP recommends setting a provisional management value of 30 µg/m³. In light of the data available, not exceeding the 30 µg/m³ value on average over one week (in practice: from 4.5 to 7 days) ensures continuous compliance with the IAQB of 100 µg/m³ with a high likelihood.

This provisional management value will no longer be used once new continuous measuring instruments have been standardised and become available at a reasonable price.

During measurement by diffusive sampling over one week (4.5 to 7 days), where $100 \mu\text{g}/\text{m}^3$ is exceeded – since this necessarily corresponds to at least one instance of the IAQB being exceeded – corrective action will have to be taken within a set delay of 6 months.

During measurement by diffusive sampling over one week (4.5 to 7 days), where the provisional management value ($30 \mu\text{g}/\text{m}^3$) is exceeded – even though the $100 \mu\text{g}/\text{m}^3$ guideline is not – and compliance with the IAQB (measured over a 1- to 4-hour time interval) is not guaranteed, sources shall have to be identified and an appropriate action plan drawn up. A new measuring campaign will then be carried out to check compliance with the IAQB or, failing that, the provisional management value. In all cases, the delay between the initial measurement and new measurement must not be longer than one year.

Regarding new buildings delivered and fitted out from 2020, the concentrations measured must be as low as possible and, in all cases, less than the IAQB or, failing that, the provisional management value. The same applies for buildings where extensive renovations are being carried out. To that end, architects and construction managers shall endeavour particularly to act on indoor FOR emission sources, interior design and construction materials.

- Measuring method

Compliance with the IAQB must be monitored via successive sampling every 1 to 4 hours when the building is occupied.

Compliance with the provisional management value may be monitored via diffusive sampling over 4.5 to 7 days using a standardised method.

In recent years, several direct-read, continuous measuring instruments have been developed, and marketed in some cases, in a bid to provide information on changes in indoor air concentrations. Using such instruments is particularly worthwhile for dynamic measurements that not only enable comparison with the benchmarks, but also identification of episodes of higher exposure over a given period and, as such, support in the search for sources in particular. The technical characteristics and performances of these instruments have not been adequately documented or validated to date, however, to be retained in the context of regulatory monitoring.

Summary of

[Rapport du 2 mai 2019 “Valeurs repères d’aide à la gestion de la qualité de l’air intérieur – le formaldéhyde »](#)

Haut Conseil de la santé publique

14 avenue Duquesne
75350 Paris 07 SP
www.hcsp.fr