GRAYWOLF SENSING SOLUTIONS
ADVANCED ENVIRONMENTAL INSTRUMENTATION

Formaldehyde Testing For IAQ Applications

What is formaldehyde?

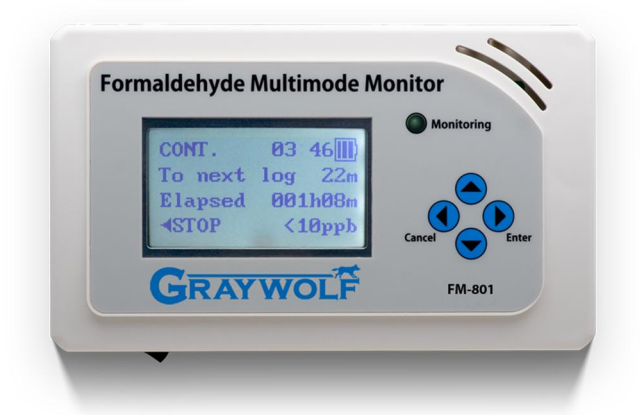
Formaldehyde (HCHO) is a colorless, reactive and pungent smelling gas. Formaldehyde is one of many compounds known as volatile organic compounds (VOCs). While it is possible to quantify the total volatile organic compounds (TVOCs) present, formaldehyde is usually of heightened interest by itself due to its significant health concerns, even at extremely low concentrations. Formaldehyde is used widely by industry in various building materials and household products.

Sources of formaldehyde

Formaldehyde may off-gas from pressed wood products such as hardwood plywood wall paneling, particle board, fiberboard, laminate flooring and furniture. HCHO may be present in the home due to household cleaners, paints, coatings, lacquers, personal care products (especially certain hair products), pet products and tobacco smoke. Other sources of formaldehyde can be from urea-formaldehyde foam insulation (UFFI), combustion processes, pesticides, textiles, fertilizers, specialty paper, glues and adhesives. Formaldehyde is also heavily used in the embalming process as a preservative in hospitals and lab animal facilities. Formaldehyde can also be generated through a reaction with ambient air in areas where ozone is present. Due to the various sources of formaldehyde, it may be present both indoors and outdoors.

Health Effects from formaldehyde

Formaldehyde is a highly toxic compound with known, detrimental health effects. Formaldehyde can cause watery eyes along with burning sensations in the throat and eyes, nausea, and difficulty breathing when healthy adults are exposed to high levels (>0.1 ppm). Elderly, very young and asthmatic populations may be at increased risk at lower exposures. As of June 2011, the US National Institute of Health's National Toxicology Program considers formaldehyde a known human carcinogen[1], while the USEPA describes it as a probable human carcinogen[2]. The World Health Organization's International Agency on Cancer (IRAC) has designated formaldehyde as the cause of several types of nose and throat cancer[3].



GrayWolf FM-801 Formaldehyde Meter

[1] NIEHS (NIH)
http://www.niehs.nih.gov/health/materials/formaldehyde.pdf
[2] USEPA http://www.epa.gov/iaq/formaldehyde.html

[3] IRAC (WHO)
http://monographs.iarc.fr/ENG/Monographs/vol88/mono88-6.pdf

Regulations for formaldehyde

There are many regulations and guidelines for formaldehyde in the US, Europe, and worldwide. US OSHA has determined a time weighted average (TWA) of 0.75 ppm with a short term elevated level (STEL) of 2 ppm for worker exposures[4]. The National Institute for Occupational Safety and Health (NIOSH) has defined a TWA of 0.016 ppm[5]. The World Health Organization (WHO) has an IAQ guideline of 0.1 mg/m^3 (0.08 ppm) over a 30-minute period[6]. Many other countries have similar, or sometimes lower exposure regulations. For example, China[7], Japan[8], Portugal[9] and UAE[10] cite a 0.08ppm maximum for their IAQ standards. France has 0.04ppm[11] and Hong Kong's "excellent class" IAQ requirement is at 0.025ppm[12]. The US Green Building Council's LEED IEQ 3.2 credit requires 4-hour TWA's to be below 0.027ppm[13], equivalent to the California EPA's 8-hour TWA[14].

Influences on Formaldehyde Emission Rates

Emission rates of materials that contain formaldehyde decrease with time. However, as temperature and/or relative humidity increase, so will the emission rate. When temperature and/or relative humidity decrease, the formaldehyde emission levels will typically decrease.

Ways to reduce exposure to formaldehyde

The ideal solution to reducing existing formaldehyde levels is to remove any formaldehyde emitting products from the area. This will greatly reduce the levels of formaldehyde and prevent other materials from absorbing formaldehyde and then re-emitting it. Increasing ventilation rates with fresh air will typically also reduce formaldehyde levels. Surfaces that are treated with formaldehyde (and have not already been coated or laminated) can be sealed by a material that does not contain formaldehyde. When choosing furnishing and building materials, make sure to check whether they contain formaldehyde. Choosing composites with Ultra Low Emission Formaldehyde (ULEF) will help reduce the levels.

Formaldehyde in the News

60 Minutes story about high formaldehyde levels found in Chinese-made flooring supplied by Lumber Liquidators: http://www.cbsnews.com/news/lumber-liquidators-linked-to-health-and-safety-violations/

Huffington Post on FEMA trailers containing high levels of formaldehyde after Hurricane Katrina: http://www.huffingtonpost.com/2012/05/29/fema-trailers-lawsuit-settlement_n_1551467.html

NBC story that electronic cigarettes lead to high emissions of formaldehyde: http://www.nbcnews.com/health/cancer/you-vape-high-levels-formaldehyde-hidden-e-cigs-n290826

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[4] Part 1910 Occupational Safety and Health Standards https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10075&p_table=STANDARDS

[5] The National Institute for Occupational Safety and Health (NIOSH) NIOSH Pocket Guide to Chemical Hazards last reviewed April 2011

[6] The World Health Organizations (WHO) Guidelines for Indoor Air Quality, Selected Pollutants (2010)

[7] Chinese Indoor Air Quality Standard, GB/T 18883-2002

[8] Japan Society for Occupational Health (JSOH) Recommendation of Occupational Exposure Limits. (2010)

[9] Regulations on HVAC Systems in Buildings (RSECE, DL 79/2006),

[10] Green Building Regulations and Specifications, 2013

[11] Dept. of Ecology, Sustainable Development, Transportation and Housing Decree No. 2012-14 of 5 January 2012

[12] The Government of the Hong Kong Special Administrative Region. Indoor Air Quality Management Group, Guidance Notes for the Management of Indoor Air Quality in Offices and Public Places, 2003

[13] US Green Building Council (USGBC) LEED 3.2 IEQ Credit, Option 2 (2013)

[14] CA EPA Air Resources Board Air Quality Standards, 2004

ABC News story discussing formaldehyde in hair straightening products: http://abcnews.go.com/US/brazilian-blowout-identify-formaldehyde-hair-smoothing-products/story?id=15821056

Measuring formaldehyde

Quantifying formaldehyde at low levels is of utmost importance for IAQ applications as not all occupants are healthy adult workers (even though such workers' productivity may be negatively impacted even by mild HCHO caused irritation). Some occupants, such as asthmatics or the elderly, are at higher risk of potentially dangerous lung irritation, and HCHO is becoming more broadly recognized as a known carcinogen. GrayWolf's FM-801 formaldehyde meter has a very low limit of detection, <10ppb (parts per *billion*), with excellent accuracy specified from 20ppb to 1ppm. The FM-801 utilizes colorimetric/photometric testing which allows for better HCHO resolution and minimal cross sensitivity with other compounds that might typically be found in IAQ environments. The FM-801 is able to display and log readings, over time, as ppb or $\mu g/m^3$. It also measures °C/°F and %RH. The FM-801 meter will provide readings every 30 minutes, eliminating the need to send out samples for analysis, greatly reducing cost and time. Reusable cartridges may log data for 2 to 3 months before requiring replacement at typical low IAQ HCHO concentrations. If certified laboratory analysis is required to meet local government or industry requirements, the FM-801 is an excellent screening tool to efficiently determine if, when or where air samples should be collected. The China National Institute of Metrology has confirmed the FM-801 accuracy specifications[15] and the China Ministry of Health has listed GrayWolf's FM-801 as an accepted methodology for measuring HCHO for the China IAQ Standard[16].

The FM-801, along with all GrayWolf units for a wide variety of parameters, are available for rental as well as purchase. The FM-801 is able to work as a stand-alone monitor, with logged data downloaded to GrayWolf's WolfSense PC data transfer and reporting software. The FM-801 may also be interfaced to other GrayWolf equipment for simultaneous display, logging and remote on-line access of multiple parameters.

Inserting a reusable cartridge into the FM-801

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[15] CNIM JJG 1022-2007 (Verification Regulation of Formaldehyde Gas Analyzer)

[16] CMH GB/T 18204.2-2014 (Examination Methods for Public Places-Part 2 Chemical Pollutants) and Photoelectric Photometry