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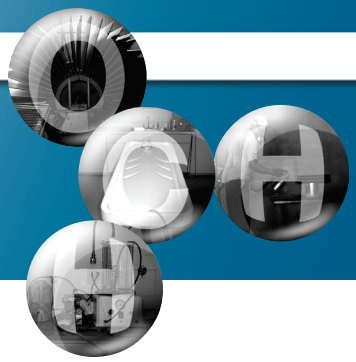
Exposure to formaldehyde in the workplace: Pathology laboratory

Nicole Goyer



PREVENTION FACT SHEET

EXPOSURE TO FORMALDEHYDE IN THE WORKPLACE

PATHOLOGY LABORATORY

FORMALDEHYDE

Under normal temperature and pressure conditions, formaldehyde (chemical formula: **HCHO**) is a **colourless gas with an acrid odour** detectable at a concentration below 1 ppm (part per million in air). Commercial formaldehyde is mainly in an aqueous solution called formol or formaline. Formaldehyde is easily released in gaseous form. There are many uses for formaldehyde and its compounds in the workplace. In pathology laboratories, formol is used as a preservative, disinfectant and dehydrating agent.

EXPOSURE TO FORMALDEHYDE HEALTH RISKS AND EFFECTS

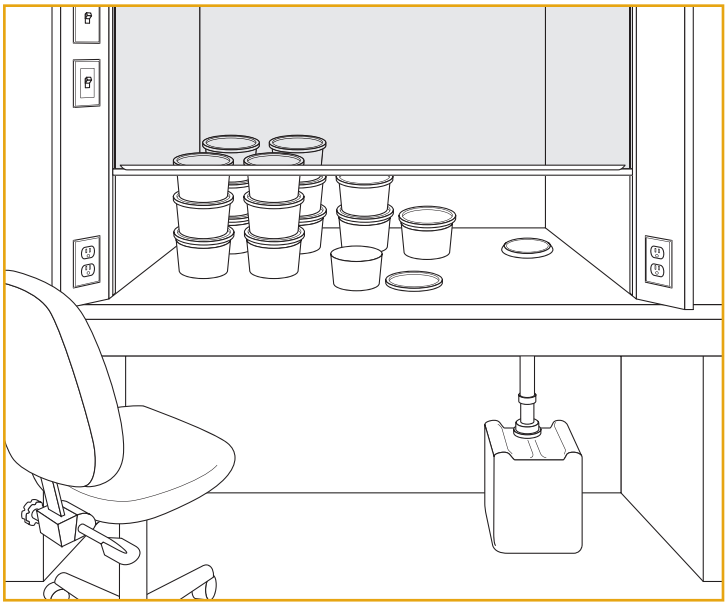
- **Formaldehyde exposure occurs in various ways.** In its gaseous form, it is absorbed by the respiratory tract, when in aqueous solution, it is absorbed through skin contact. The Québec[1] current permissible exposure value in air is 2 ppm ceiling, meaning a value that must never be exceeded during any length of time whatsoever[2]. It is a substance whose exposure must be reduced to a minimum and whose recirculation is prohibited.

- **Direct skin contact -** Formaldehyde can cause skin lesions such as irritation and irritant or allergic dermatitis. The symptoms are itching, tingling and redness. Skin sensitization is likely to occur after contact with aqueous solutions of formaldehyde or even with solids or resins containing free formaldehyde. Once a person is sensitized, skin allergy symptoms may occur at every contact with solutions of increasingly low concentration.

- **Respiratory tract -** Following exposure to contaminated air, the first effect is irritation of the eyes and respiratory tract. The associated symptoms are tingling, redness or burning of the nose and throat, nasal discharge and watery eyes. These symptoms are generally negligible to slight for exposures in the order of 0.75 to 1 ppm. They can become bothersome and even intolerable at higher concentrations mainly when they exceed 2 to 3 ppm.

  The appearance of effects is not related to the duration of exposure. The effects appear soon after the exposure and do not worsen with time. There does not seem to be a cumulative effect from exposure. The effects are reversible and stop shortly after the exposure stops.

- **Occupational exposure over several years -** Long-term exposure has been related to causing cancer of the nasopharynx. The International Agency for Research on Cancer has furthermore classified it as a human carcinogen since June 2004. In Québec, considering the concentrations present in the workplace and the number of exposed workers, the number of cases of cancer of the nasopharynx related to this exposure remains very low.



Chemical fume hood with sash

According to prudent estimates, less than one Québec worker per year would develop a cancer attributable to formaldehyde following daily exposure for 40 years.

The employer has the obligation to ensure that the air concentration in the worker's breathing zone does not exceed the permissible value specified in Annex 1 of the Règlement sur la santé et la sécurité du travail[2]. The measuring frequency depends on the reported values. Measurements must also be done following any workplace modifications. Formaldehyde is measured using IRSST methods and sampling strategy that comply with industrial hygiene requirements. To evaluate a time-weighted average exposure value, formaldehyde is sampled using a tube or a passive dosimeter; analysis is done in the laboratory by chromatography. The ceiling value is measured by direct-reading instruments, but the presence of some other products can affect the results of these analyzers.

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EMISSION SOURCES AND HAZARDOUS TASKS

- Formaldehyde comes primarily from the handling of formol solutions, specimens and waste. All workers working in this environment can be exposed to high formaldehyde concentrations for short periods.

FACTORS AFFECTING HCHO EMISSION

- concentration of the formaldehyde solution
- size and number of anatomical parts to be processed
- work methods
- number of workstations in the same room
- dimensions of the premises
- type and efficiency of the fume hoods
- type and efficiency of the general ventilation

EXPOSURE SOURCES	MAXIMUM CONCENTRATIONS MEASURED IN 10 QUÉBEC LABORATORIES (PPM)
HANDLING OF FORMALDEHYDE	
Solution preparation	1.0 – 2.0
Jar filling	1.0 – 2.0
Decanting of waste formaldehyde into the recycling device	0.3 – 0.75
Formaldehyde neutralization	Not measured
HANDLING OF SPECIMENS	
Placing anatomical specimens in jars	Not measured
Specimen handling during macroscopy	< 0.3 – > 2.0
Tasks not carried out under a fume hood (ex : washing of specimens)	0.7 – > 2.0
Inserting cassettes into the tissue preparer	1.0 – 2.0
Use of mercuric stain	Not measured
WASTE HANDLING	
Draining of specimens and waste solutions	0.3 – > 2.0
Handling of biomedical waste bags	Not measured
Handling and rinsing of used jars	Not measured
EQUIPMENT MAINTENANCE	
Tissue preparer	1.1 – > 2.0
Recycling device	0.3 – 0.75
EMISSION SOURCES / EQUIPMENT	
Tissue preparer (leaks)	Not measured
Recycling device (leaks)	Not measured
Storage of specimens	0.3 – 0.75
Storage of new and waste formaldehyde solutions	Not measured
Garbage pail for emptied jars, contaminated gloves and paper	Not measured
Biomedical waste pail	> 2.0

MEANS OF IMPROVEMENT

Collective control means reducing the risk of exposure and health effects. Personal protective equipment is required if other means are not sufficient to reduce exposure. For tasks that involve the use of formaldehyde, prevention procedures must be well defined and set up to minimize exposure.

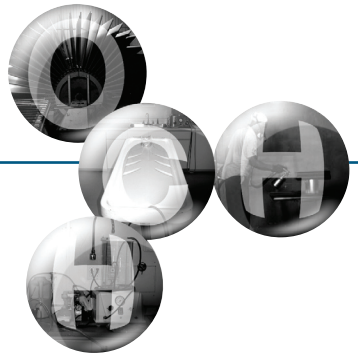
- **Fume hoods** – The installation of fume hoods above the sources (tissue preparing equipment and formaldehyde recycling equipment, pails for medical waste and contaminated equipment, solution and specimen storage cupboard) and their confinement minimize its diffusion in the work environment.

The following tasks should be carried out under a fume hood: formaldehyde solution preparation, jar filling, specimen draining and formaldehyde neutralization. In these cases, the worker can be properly protected by a chemical fume hood if it is used according to requirements, meaning with the sash lowered as much as possible (illustration on front page).

Macroscopy must also be performed under a fume hood. However a chemical fume hood is not recommended. As this specific task requires visual sharpness and precision, the worker tends to bend over the specimen and insert his head inside the fume hood. The ideal system should have an airflow that removes the contaminant from the worker's breathing zone, like a multiple slot hood[3], as illustrated on next page.

- **Work procedures** – They must minimize formaldehyde emissions. Examples include closing of unused jars, appropriate storage of solutions and specimens, immediate disposal of impregnated cloths, periodic checking of equipment. For specimens, using disposable plastic containers or using solution-ready jars prepared by an outside company are good options. Some laboratories prefer this option[4].

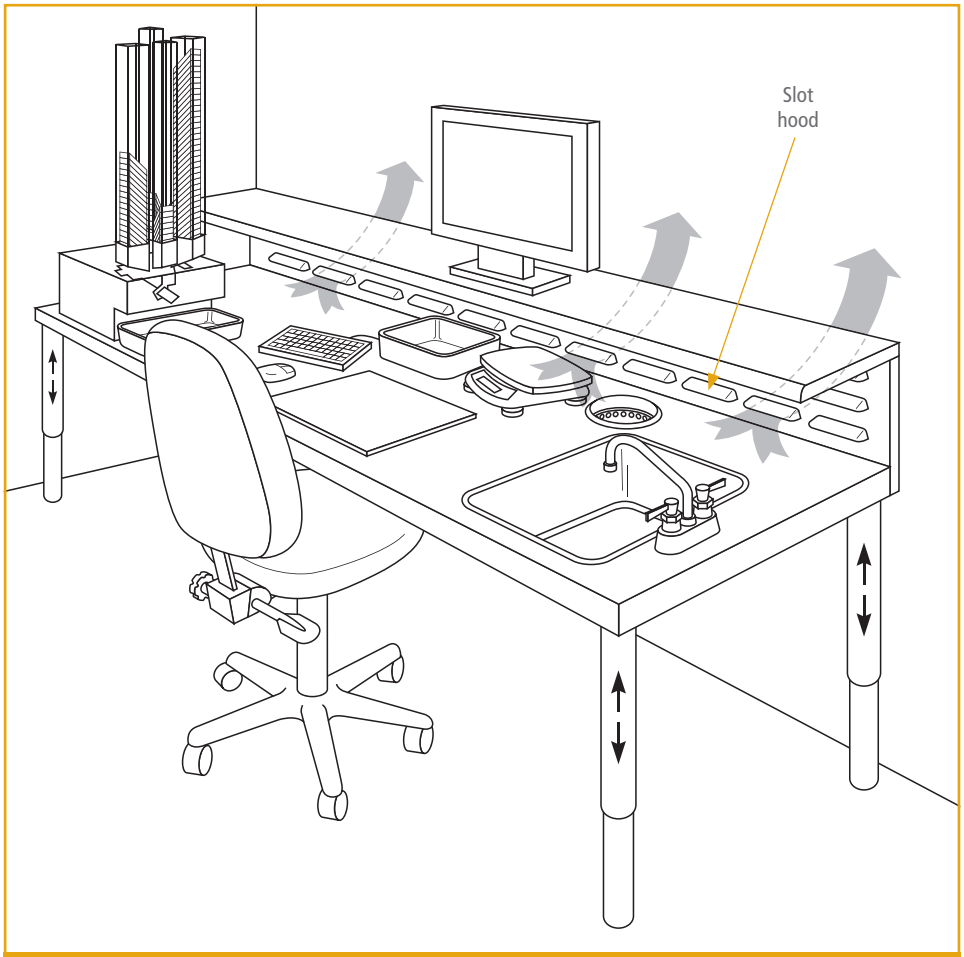
- **General ventilation** – Allows pollutants to dilute. The total number of air changes must be six, and two for outdoor air[5].



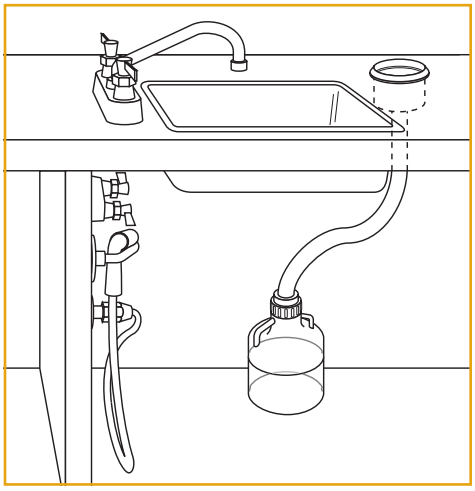
EXPOSURE CONTROL

- The most effective way to control workers' exposure to a chemical contaminant is by replacing the product by a less hazardous one. In pathology, different substitution products are mentioned in the literature but none is the subject of consensus, although some substitute products as glyoxal are successfully used in the United States.

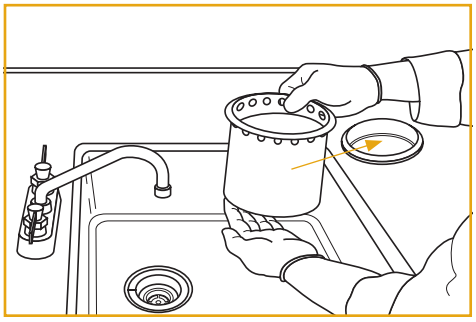
- The possibility of reducing the concentration or of purchasing less concentrated solutions should be studied. We know that many laboratories successfully use 10% formaldehyde solutions. Are less concentrated solutions acceptable? Some laboratories handle fresh specimens, mainly placentas, reducing the use of formaldehyde solution.



AIR FLOW SYSTEM WITH MULTIPLE SLOT HOOD



Clear jar allowing to see the filling level and easy to empty.



Screen to catch anatomical remains from the waste formaldehyde solution.

INFORMATION AND TRAINING ON THE RISKS ASSOCIATED WITH FORMALDEHYDE EXPOSURE, ON THE EMISSION SOURCES AND MOST POLLUTING TASKS, ON MEANS OF CONTROL INCLUDING WORK TECHNIQUES AND METHODS, AND ON PERSONAL PROTECTIVE EQUIPMENT, ARE KEY ASPECTS IN CONTROLLING EXPOSURE.

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PERSONAL PROTECTIVE EQUIPMENT

- **Respiratory tract protection** - The type of respirator that will best protect the respiratory track depends on the level of protection needed. A respirator's level of protection indicates its effectiveness. It represents the theoretical relationship between the concentration in the work environment and the concentration inside the respiratory protective equipment. The respirator must be selected according to both work conditions and worker's morphology.

  Formaldehyde concentrations below 20 ppm and up to the permissible value: Wearing a filter cartridge mask is recommended. Depending on the required protection factor, a full mask with face shield (protection factor of 100) or a half-mask (protection factor of 10) is to be used. In the case of a half-mask, safety goggles must also be worn.

  Concentrations unknown or above 20 ppm: These concentrations cause an immediate danger to life or health (IDLH), wearing a self-contained breathing apparatus or air-supply respirator is mandatory.

- **Skin protection - Hand protection** is needed when contact is possible. Nitrile, neoprene or butyl gloves offer a good resistance to formaldehyde.

  Body protection is essential in case of splash and a waterproof smock or plastic apron must be used. They can either be disposable or washable. In this case, they must be washed after each use.

- **Other considerations** - Employers must elaborate procedures in the event of spills, leaks or breakage and make them known to workers. These procedures must take into account the volume of product involved, ventilation conditions, existing or not of a specialized team, and environment protection requirements. Events must be declared and investigated. Under the Québec Regulation respecting hazardous materials, it is prohibited to release waste formaldehyde solutions into sewer systems without previously obtaining a permit.

NEITHER A SURGICAL MASK NOR A CLASS FFP 2 ANTI-ODOUR MASK NOR A N-95 PARTICLE MASK ARE DESIGNED FOR PROTECTION AGAINST FORMALDEHYDE.

NOTES

1. American Conference of Governmental Industrial Hygienists recommend a ceiling value of 0.3 ppm
2. GOUVERNEMENT DU QUÉBEC. Règlement sur la santé et sécurité du travail, S-2.1, r.19.01, Éditeur officiel du Québec, 2007, 220 p.
3. ASSTSAS. Travail de macroscopie – Secteur pathologie, Fiche technique laboratoire (FTLS), 2006 (www.asstsas.qc.ca)
4. Commercially available work equipment such as mats and cloths soaked with neutralizer could, according to suppliers, reduce the formaldehyde emissions.
5. CORPORATION D'HÉBERGEMENT DU QUÉBEC. Guide sur la qualité de l'air intérieur dans les établissements du réseau de la santé et des services sociaux, 2005 (www.irsst.qc.ca/fr_publicationsirsst_100118.html)

FOR MORE INFORMATION

GOYER N., et al. Prevention guide : formaldehyde in the workplace, IRSST, Rapport RG-473. 2006 (www.irsst.qc.ca/fr/_publicationirsst_100214.html)
GOYER N., et al. Impacts d'un abaissement de la valeur d'exposition admissible au formaldéhyde, IRSST, Rapport R-386. 2004 (www.irsst.qc.ca/fr/_publicationirsst_100085.html).
CARRIER G., et al. Annex 13 : Health impact of an occupational exposure to formaldehyde. IRSST, Report RA13-386. 2004.
(www.irsst.qc.ca/fr/_publicationirsst_100178.html)
GOYER N., et al. Annexe 8 : Laboratoires de pathologie. IRSST, Rapport RA8-386. 2004.
(www.irsst.qc.ca/fr/_publicationirsst_100093.html).

Content of this prevention fact sheet was drawn from the research carried out by the IRSST. Production was assumed by IRSST-ASSTAS and is accessible on both IRSST and ASSTSAS websites.
For more information on equipments, go to the ASSTSAS website, under ''Répertoire des équipments".

ASSTSAS
ensemble en prévention

Association paritaire pour la santé et la sécurité
du travail du secteur affaires sociales (ASSTSAS)
5100, rue Sherbrooke Est, bureau 950
Montréal (Québec)
H1V 3R9
Téléphone : 514 253-6871 ou 1 800 361-4528
Télécopieur : 514 253-1443
Courrier électronique : info@asstsas.qc.ca
www.asstsas.qc.ca

irsst

505, boul. De Maisonneuve Ouest,
Montréal (Québec)
H3A 3C2
Téléphone : 514 288-1551
Télécopieur : 514 288-9399
www.irsst.qc.ca
No IRSST : RG3-471