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## Exposure to formaldehyde in the workplace: Wood furniture manufacturing

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## 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).
- There are many uses for formaldehyde and its compounds in the workplace. In the wood furniture manufacturing sector, formaldehyde is mainly found in acid **catalyzed varnishes**, also called “two-part varnishes”. Some glues, including the one used for gluing edges (straight edge of a panel), may also contain it.

## EXPOSURE TO FORMALDEHYDE HEALTH RISKS AND EFFECTS

- In the workplace, 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. Wearing personal protective equipment reduces the risk of exposure and **health effects**.
- **The current permissible exposure value in air is 2 ppm, ceiling** –meaning a value never to be exceeded during any length of time whatsoever. Formaldehyde is a substance to which exposure must be reduced to a minimum and whose recirculation is prohibited.
- **In the case of direct skin contact, formaldehyde can cause skin lesions** such as irritation, irritant and 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. When a person is sensitized, skin allergy symptoms may occur at every contact with solutions of increasingly low concentration.
- **Following exposure to contaminated air, the first effect is irritation of the eyes and respiratory tract.** The related 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. These 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.
- **In the case of occupational exposure over several years, formaldehyde 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 Quebec, 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. According to prudent estimates, less than one Quebec worker per year would develop cancer attributable to formaldehyde following daily exposure for 40 years.
- **Formaldehyde is measured using IRSST methods.** 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.

# WOOD FURNITURE MANUFACTURING

## EMISSION SOURCES AND HAZARDOUS TASKS

- **Formaldehyde comes primarily from the type of coating used.** For formaldehyde to be released, the coating has to be aminated-resin-based or phenolic-resin-based. The latter is used only for metal furniture; aminated resins are used in the manufacture of wood and metal furniture.
- Formaldehyde is released during the **preparation** of varnishes and paints, their **application** (mainly when spraying with a pneumatic gun) and **drying**. When paint is applied inside a well-ventilated booth, the formaldehyde is exhausted and does not contaminate the work environment. However, the painter inside the booth can be significantly exposed if he is located in the direction of flow of the varnish mist.
- For **other tasks such as finishing, hardware installation and shipping**, airborne formaldehyde can come from furniture that is drying, from applying the varnish and from drying zones.
- **The most exposed workers** are finishing painters, preparation painters, colorists and some manual labourers, including those working at the dryer or oven outfeeds, as well as maintenance personnel (mechanics, electricians), foremen and supervisors.

EXPOSURE SOURCES	MAXIMUM CONCENTRATIONS IN 9 PLANTS (PPM)
<b>TASKS AT RISK OF FORMALDEHYDE EXPOSURE</b>	
Paint preparation	< 0.3 to > 2.0
Application of preparation coatings	0.5 to > 2.0
Application of varnish	0.6 to > 2.0
Sanding between coats of varnish	0.4 to > 2.0
Unloading of furniture (from the oven)	< 0.3 to > 2.0
Repairing of imperfections	0.5 to 1.7
Installation of hardware	< 0.3 to 1.8
Cleaning of guns	Not measured
<b>EMISSION SOURCES</b>	
Storage of varnishes	Not measured
Paint booth	0.6 to > 2.0
Drying of furniture	< 0.3 to > 2.0
Storage of furniture	< 0.3 to 1.8



## MEANS OF IMPROVEMENT

- The most effective way to control workers' exposure to a chemical contaminant is by **replacing the product with a less hazardous one**. In wood furniture manufacturing, formaldehyde-free glues may be used. For varnishes, different types of formaldehyde-free coatings exist, mainly those in the aqueous phase: cellulose nitrate, acrylic, ultraviolet drying, polyesters, polyurethanes, and those in powder form. Several factors affect the choice, such as the product's toxicity, the type of furniture, the desired finish, the cost of equipment replacement, current environmental regulations, etc. All these factors must be taken into account when substitution is considered.
- **Work procedures** must minimize formaldehyde emissions: closing of unused jars; proper storage of paints, varnishes and other products; immediate disposal of impregnated cloths; periodic checking of equipment.
- **The confinement** of formaldehyde emissions and the **installation of fume hoods** above the sources will limit the dispersion of pollutants in the work environment.
- Paints and varnishes should always be prepared and sprayed in a **ventilated booth**. When inside the booth, the painter must not stand between the part to be varnished and the polluted air exhaust outlet. A collection system should also be installed above the drying zone (oven) and be in operation until the end of the drying cycle.
- **General ventilation** in the furniture finishing and storage areas will dissipate the formaldehyde that could still be released. **Confinement** of these areas will limit the dispersion and will reduce the flow necessary for general ventilation.
- For tasks during which the worker is often in areas where the formaldehyde concentration is high, **prevention procedures** such as wearing personal protective equipment must be well established and followed.
- Procedures in the event of **spills, leaks or breakage** must be available and known by the workers.



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

# WOOD FURNITURE MANUFACTURING

## PERSONAL PROTECTIVE EQUIPMENT

The goal of the requirements in the Quebec Act regarding occupational health and safety is to eliminate dangers at the source. When required, protective equipment must be selected according to needs:



- The type of respirator that will best **protect the respiratory tract** 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. A factor of 10 therefore means that the concentration inside the mask is 10 times lower than that in the work environment.
- In the case of 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) should be used. In the case of a half-mask, safety goggles must also be worn.
- For concentrations above 20 ppm, causing an immediate danger to life or health (IDLH), wearing a self-contained breathing apparatus or air-supply respirator is mandatory.
- For **hand protection**, nitrile, neoprene or butyl gloves offer a good resistance to formaldehyde.
- To **protect the body**, a disposable coverall or waterproof coverall washed after use is recommended.

## FOR MORE INFORMATION

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