

# Factors Affecting Employee Health & Comfort



## The Formaldehyde Furor

The front page headline reads: "Formaldehyde Cover-up Led to Record Settlement." This story, which appeared in a recent edition of a leading indoor air quality law journal, shows that while public interest in environmental issues may wax and wane, formaldehyde in indoor air is the particularly hardy controversy which is not likely to disappear from public view any time soon.

Formaldehyde is an organic chemical with the formula HCHO. This chemical first began to gain attention in the mid-seventies when it was realized that a number of pressed wood products used in mobile homes were giving off gaseous formaldehyde at levels that were causing health problems to the occupants of these homes.

The most common symptom of exposure to formaldehyde are burning and watering of the eyes and irritation of the nose and throat. Higher levels of formaldehyde can lead to headaches, nausea, chest tightness and wheezing, skin rashes and allergic reactions. Insomnia and depression also have been linked to formaldehyde exposure.

### LONG-TERM HEALTH PROBLEMS

Like many chemicals, formaldehyde may cause sensitization in some people. This means that after being exposed one or more times to relatively high concentrations of the substance, an individual develops extreme sensitivity to very low concentrations, such as those found in typical indoor spaces, or even some outdoor environments.

Like many aspects of this substance, there is controversy over the likelihood of formaldehyde causing sensitization, and there are estimates that sensitization can occur, ranging from zero to five percent of the general population. Particular groups of people do tend to be more sensitive to formaldehyde, however, such as the elderly, young infants and those with a history of allergic reactions or respiratory problems. Many of these people obviously tend to spend a lot of their time at home where their period of exposure might be

longer. The questions of whether formaldehyde causes cancer is a particularly thorny issue. In 1981, the Chemical Industry Institute of Toxicology (CIIT) conducted a two year exposure study on rats and mice. These rodents were exposed over their lifetime to formaldehyde gas at concentrations ranging from two parts per million (ppm) to 15 ppm. Those animals exposed to the



Glass impingers are used to measure levels of formaldehyde

highest concentrations developed statistically significant numbers of nasal cancer cases, although these animals also showed physical damage to their nasal passages at these high levels of formaldehyde.

Some claim that this means there is no 'safe' level of exposure; others say that the cancer risk below a certain threshold is virtually non-existent. For instance, at high enough doses even table salt will poten-

tially cause stomach cancer. The Formaldehyde Institute cites a large body of epidemiologic research on formaldehyde workers which fails to link formaldehyde with nasal cancer.

Despite a lack of broad epidemiologic evidence, and based primarily on the high dose animal studies, in May of 1984, the EPA stated that formaldehyde presents a significant risk of widespread harm to humans from cancer. They classified formaldehyde as a Group B1 (probable human carcinogen) in 1987, on the basis of 'limited' exposure evidence. However, their final formal position on the issue has yet to be released, and in recent months, the EPA has back-pedalled somewhat in the light of new, more sophisticated pharmacokinetic studies with rats and primates which show a lower nasal cancer risk than previously estimated.

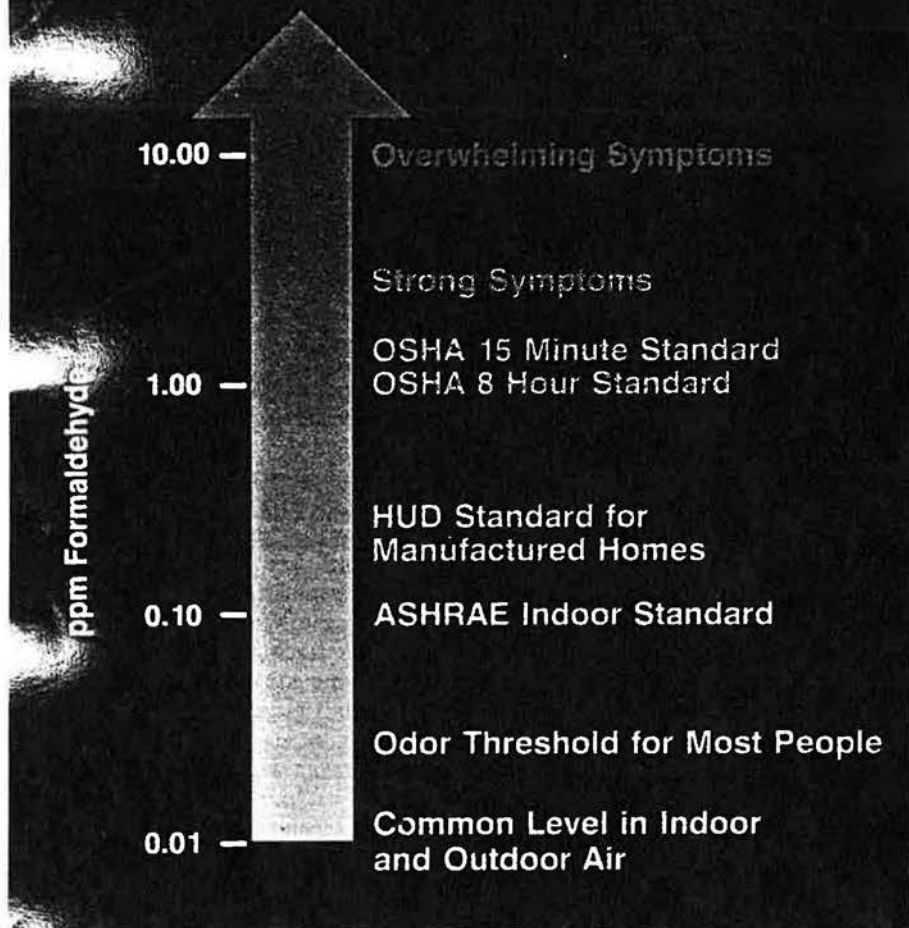
The United States Consumer Product Safety Commission (CPSC) also was forced to hedge on the formaldehyde issue after they banned the use of urea formaldehyde foam insulation in 1982. They were taken to court a year later and the ban was overturned after the Federal Court found insufficient health risks to justify such a ban.

### USES

The formaldehyde controversy is particularly acute because of the widespread use of this product. The Formaldehyde Institute, in its literature, lists more than 80 widely used products which contain formaldehyde, from milk, to toilet seats, to explosives. The use of urea formaldehyde resins in the building industry, however, has raised the most concern.

Pressed wood products used for flooring, walls and ceilings often use urea formaldehyde adhesives to bond the fibers and particles together, as well as to attach veneers or laminates. The adhesive is cured and most of the formaldehyde is bonded permanently as part of the adhesive. Some unreacted formaldehyde soaks into the wood chips and is released later as free formaldehyde during the life of the prod-

# FORMALDEHYDE LEVELS IN INDOOR AIR



uct.

This will continue for a variable period, depending to a large extent on temperature and relative humidity conditions. This is because water vapor reacts even with the cured urea formaldehyde adhesive to release 'hydrolytic' formaldehyde. An increase of 10 percent in relative humidity can increase formaldehyde emission by 30 percent, and an increase of five degrees Fahrenheit in temperature can cause emission rates to rise by 50 percent.

Unfortunately, a substantial number of mobile home communities, in which the use of pressed wood products is extensive, are established in 'sunbelt' areas, Florida and Texas in the USA for instance. These areas have long hot, humid summers, thereby encouraging the release of formaldehyde from these products.

Fortunately, the emission levels for particleboard do decline during the life of the product, and a recent study showed a 'half life' of 216 days, or 31 weeks for the emissions to reach half of their original value.

Other products which contain formalde-

hyde and are of concern include urea formaldehyde insulation foam, although sales of this product have dropped dramatically in recent years. Some crease-resistant clothing and coated paper products also contain this gas, as do draperies and other interior fabrics, though nowadays in lesser amounts. Very minor sources of formaldehyde in buildings include cosmetics, paper towels, combustion sources including smoking and car exhausts.

## STANDARDS

Depending on the use of the building, indoor standards will vary widely. Standards for industrial use are set by the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH). They limit formaldehyde exposure to a Threshold Limit Value (TLV) of one ppm over an eight hour day and a Short Term Exposure Limit (STEL) of two ppm for a maximum of 15 minutes during a work day.

Even at the lower day-long limit of one

ppm, most people would be able to sense formaldehyde and while these limits may be suitable for prevention of health problems, they would not be appropriate for a comfort level in homes and offices. The Department of Housing and Urban Development (HUD), after reviewing emission rates from particleboards and ambient formaldehyde levels in manufactured homes, concluded that a standard of 0.4 ppm in homes was achievable, using currently available technology. This ambient limit is combined with product standards for plywood and particleboards to limit their emissions. Plywood and particleboard are tested to release a maximum of 0.2 ppm and 0.3 ppm respectively. These emissions are measured in a large test chamber at controlled flow rates, temperatures and relative humidities.

The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) sets standards for chemicals in general commercial buildings based on one-tenth of the eight-hour OSHA TLV standard. This is in recognition of the fact that office workers are likely to be a more variable population than factory workers. On this assumption, a working ASHRAE guideline for office exposure to formaldehyde is 0.1 ppm. It is widely recognized, however, that even this level will cause irritation to some sensitive individuals and a general odor threshold for this substance is probably around 0.05 ppm.

## MITIGATION

Good control of excessive humidities and temperatures is an effective method of limiting formaldehyde emissions from pressed wood products indoors, as are adequate ventilation rates, at least in compliance with applicable ASHRAE ventilation standards. Additional mitigation measures include sealing the surfaces and edges of these pressed-wood products. Certain sealants are more effective than others, the most effective being laminates, vinyls, and oil enamel or polyurethane paints. Latex paints and penetrating sealer/stain prod-

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## On the Cover

Four Millbank's location and impressive array of amenities offers its tenants a complete lifestyle of ease and luxury.

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## C. G. Petterssen

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flexible space system is profitable for the developer because the system allows for a redesign of the space for a new tenant in record time, limiting the months of renovation often needed between tenants. This saves property owners downtime in rents.

Even more important is the employee productivity that healthy buildings generate, Petterssen says. "Through our development experience, we have learned that using the healthy building concept promotes employee health and comfort in the workplace." It makes solid business sense to promote this concept during a time

when employers are becoming increasingly concerned about the monetary and legal effects of sick building syndrome, he says.

With the success of Four Millbank and two other European complexes under his belt, Petterssen plans to continue creating healthy environments across the world.

In the fall of 1991, Petterssen will be sponsoring "healthy building" seminars in Strasbourg, Gothenburg, Zurich and Brussels to promote the role that designers and architects can play in enhancing the quality of life in the office.

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ucts are less effective. Other methods include use of special absorbent filters in the HVAC system, usually containing potassium permanganate beads which will need replacing from time to time. One method sometimes suggested which should never be used is the use of strong ammonia solution which will produce only a temporary reduction in formaldehyde levels while adding yet another irritating pollutant to the indoor environment.

### COVER-UP

Finally, what about the 'Formaldehyde Cover-Up' headline? As with any potentially irritating substance found indoors, formaldehyde has seen its share of environmental law suits. In one case, a payment of more than US \$600,000 was made to settle the claims of a Texas family who developed

"reactive airway disease" because of formaldehyde exposure in their manufactured home. (Slaughter v. Kaufman and Broad Home Systems, Inc. et. al (Indoor Pollution Law Report, Feb. 1991.)) The defendant's case was compromised after the local manufacturers association accidentally opened all its files for inspection by the plaintiff's legal counsel. Internal correspondence between the Formaldehyde Institute and the local association showed plans for future defense of their industry—not a surprising thing to find in manufacturers association files, but nevertheless embarrassing enough to damage their chances in a legal hearing. One thing is certain, while controversy about this widespread and useful chemical will rage on, exposure to formaldehyde will remain a fact for many years to come.