

The Serious Public Health Issues Resulting from Formaldehyde Exposures Within FEMA Travel Trailers Issued to Hurricane Disaster Victims, and Recommended Action Items

**Testimony of
Mary C. DeVany
before the
Committee on Oversight and Government Reform
U.S. House of Representatives
July 19, 2007**

1. Introduction and Professional Background

I have been an occupational and community health and safety engineer (industrial hygienist) for 30 years. Industrial hygienists are guardians of occupational and community health and safety; we are scientists who work like community and workplace detectives – searching for hazards and exposures that may impact health and safety. We devise methods to eliminate or at least limit and control these harmful conditions – including exposures to harmful chemicals, noise, biological contaminants, radiation, vibration and other physical hazards to protect community and workplace health and safety. Educational and professional credentials include: Certified Safety Professional (CSP) in Comprehensive Practice; Certified Hazardous Materials Manager at the Master Level (CHMM); and MS from Loyola University of Chicago in biology – areas of concentration: biochemistry and human physiology.

For more than 20 years I have owned and operated an international occupational safety, health and environmental consulting company. My main areas of interest include indoor air quality, reproductive system toxicology, control of hazardous atmospheres and development of ventilation and protective equipment measures to protect people from hazardous exposures.

I have been active in the local and national levels in the American Society of Safety Engineers (ASSE), the American Industrial Hygiene Association (AIHA) and the American Public Health Association (APHA). I have served on the OR Governor's Steering Committee for Occupational Safety and Health, the WA Governor's Accident Prevention Committee (chair, appointed by the governor), have chaired national committees on Emerging (Hazards) Issues, Confined Spaces, and Social Concerns, and served on the national Global Sweatshops Task Force and on the international Joint Industrial Hygiene Ethics Committee. My pro bono work also includes being the Workplace Technical Advisor to the Sierra Club. That is how I got involved in this issue; and I am grateful for the privilege of speaking with you and discussing this important public health concern.

2. Formaldehyde: Definition and Uses

Formaldehyde is a colorless, flammable, strong, pungent-smelling gas often mixed with water at ~ 37% to make a liquid formaldehyde solution. It is an important industrial chemical used to manufacture building materials and to produce many commercial, industrial and household products.

It is used in pressed wood products such as particleboard, plywood, and fiberboard, glues and adhesives, permanent press fabrics, paper product coatings, and certain insulation materials. In addition, formaldehyde is commonly used as an industrial fungicide, germicide, and disinfectant, and as a preservative in mortuaries and medical laboratories.

3. Travel Trailer Manufacturing Process

Formaldehyde is commonly used in pressed wood products such as particleboard, plywood, and fiberboard, as parts of the subfloors cabinetry and furniture. It is also used in their manufacturing process and in glues and adhesives for these materials as well as countertops and carpeting.

4. Formaldehyde Standards

Overview: Many standards exist because they are developed to protect different populations and to protect these populations for varying durations of exposures. In general, the longer the duration, the lower the exposure level can be to avoid adverse effects.

Standards set to protect the adult working population at work, since this represents only 40 hours per week of exposure and a healthier population, can allow higher levels. Standards set by the military, representing a selected very healthy population screened to exclude any medically compromised soldiers/sailors, can be even higher.

OSHA (Occupational Safety and Health Administration): After extensive rulemaking, OSHA issued a comprehensive regulation covering occupational exposure to formaldehyde, 29 CFR 1910.1048. This rule reduced the permissible exposure limits (PELs) to 0.75 ppm (part formaldehyde per million parts of air) as an 8-hour time-weighted average (TWA₈) and a short-term exposure limit (STEL) of 2 ppm for a 15 minute time period. OSHA recognizes formaldehyde as a potential occupational carcinogen and also regulates formaldehyde for its irritating, sensitizing and toxic effects. The rule was based on a wide range of evidence including animal bioassays and epidemiological evidence and is designed to most protect workers, but not those already sensitized or with pre-existing medical conditions, from cancer and other harmful health effects but not from discomfort. This standard was promulgated with the understanding that *workers will only be exposed for 8 hours/day and no more than 40 hours/week*, and that the time outside these 40 hours will have no formaldehyde exposures (*exposure recovery time*). Note that the adult population able to work a 40-hour work week is, as a group, much healthier and able to endure exposures that the elderly, the very young, and the medically compromised cannot. Also, this standard only allows 40 hours of exposure

at this level. If overtime is worked, calculations must be performed that reduce that maximum allowable exposure level.¹

HUD (Housing and Urban Development): For more than 20 years HUD has regulated the production of manufactured homes to reduce the associated hazards to future occupants. Included are regulations limiting formaldehyde emissions in plywood materials to no more than 0.2 ppm and in particleboard materials to no more than 0.3 ppm. The production facility must also establish procedures to identify potential increases in formaldehyde emissions from other sources and have an independent testing laboratory observe or conduct the emissions testing.² These standards were developed to protect the general public from health effects of exposures to formaldehyde in their living quarters. These levels, mixed in the general air of the manufactured home, will normally keep emissions below 0.01 ppm even in areas such as the kitchen.

HUD also monitors state plans and third party inspection agencies to ensure their oversight is adequate and is authorized to take administrative action against them for violations.²

ATSDR (Agency for Toxic Substances and Disease Registry): The ATSDR has established inhalation minimal risk level (MRL) as follows:

Acute MRL: 0.04 ppm (1-14 days of exposure)

Intermediate duration MRL: 0.03 ppm (>14-364 days of exposure)

Chronic duration MRL: 0.008 ppm (365 or more days of exposure)

These MRS's are based upon respiratory effects in humans. *The MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure.*³

TCEQ (The Texas Commission on Environmental Quality): The Effects Screening levels of 2003 are set as chemical-specific air concentrations set to protect human health and welfare. Short-term ESL's are based on data concerning acute health effects, the potential for odors to be a nuisance, and effects on vegetation, while long-term ESL's are based on data concerning chronic health and vegetation effects. ESL's are as follows:

Short-Term ESL (1 hour): 0.012 ppm

Long-Term ESL (1 year): 0.0012 ppm⁴

NIOSH (National Institute of Occupational Safety and Health), U.S. Dept. of Health and Human Services, Center for Disease Control and Prevention (CDC):

NIOSH develops Recommended Exposure levels designed to protect all workers. These are:

10-hour Time Weighted Average (with 14 hours of non exposure recovery time): 0.016 ppm

Ceiling Level: 0.1 ppm

IDLH (Immediately Dangerous to Life and Health): 20 ppm⁵

ACGIH (American Conference of Governmental Industrial Hygienists): Workplace Threshold Limit Value (TLV) for a 15 minute time weighted average in the workplace 4 times per 8-hour shift with 16 hours recovery time: 0.3 ppm⁶

WHO (World Health Organization) and **Health Canada**: These organizations have standards designed to protect against cancer – the threshold exposure level at which there is a negligible risk of upper respiratory tract cancer in humans due to cytotoxic (cellular) damage to the nasal mucosa. These standards are for short-term exposures only, with subsequent zero (negligible) levels of exposure for recovery:

WHO: 30-minute average: 0.08 ppm (0.1 mg/m³)⁷

Health Canada: Residential Indoor Air Quality Guidelines, 1-hr exposure limit: 0.1 ppm and 8-hour exposure limit: 0.04 ppm⁸

Council Subcommittee on Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants: These standards are set for sailors screened for physical fitness, living on submarines. As can be seen from these values, and revising standards to account for current research and health effects knowledge these levels are proposed to be even lower than those for the American workforce:

Current level for 1-hour exposure: 3 ppm; proposed: 0.4 ppm

Current level 24-hour exposure: 1 ppm; proposed: 0.1 ppm⁹

5. Short-Term Health Effects of Formaldehyde Exposure

List of Effects:

- Sore throat
- Coughing
- Mucous membrane irritation, runny nose
- Sinus irritation
- Respiratory irritation
- Burning, stinging, watery eyes
- Chest congestion
- Skin sensitivity and rashes

When formaldehyde is present in the air at levels exceeding 0.1 ppm, many individuals may experience health effects such as watery eyes; burning sensations of the eyes, nose, and throat; coughing; wheezing; nausea; and skin irritation. Some people are very sensitive to formaldehyde, while others have no reaction to the same level of exposure.

6. Long Term Formaldehyde Health Effects and Cancer Potential

Although the short-term health effects of formaldehyde exposure are well known, less is known about its potential long-term health effects. In 1980, laboratory studies showed that exposure to formaldehyde could cause nasal cancer in rats. This finding raised the question of whether formaldehyde exposure could also cause cancer in humans. In 1987, the U.S. Environmental Protection Agency (EPA) classified formaldehyde as a probable human carcinogen under conditions of unusually high or prolonged exposure (1). Since that time, some studies of industrial workers have suggested that formaldehyde exposure is associated with nasal cancer and nasopharyngeal cancer, and possibly with leukemia. In 1995, the International Agency for Research on Cancer (IARC) concluded that formaldehyde is a probable human carcinogen. And in a reevaluation of existing data in June 2004, the IARC reclassified formaldehyde as a known human carcinogen.

Since 1980, the National Cancer Institute (NCI) has conducted studies to determine whether there is an association between occupational exposure to formaldehyde and an increase in the risk of cancer. The results of this research have provided the EPA and the Occupational Safety and Health Administration (OSHA) with information to evaluate the potential health effects of workplace exposure to formaldehyde.

Long-term effects of formaldehyde have been evaluated in epidemiological studies (studies that attempt to uncover the patterns and causes of disease in groups of people). One type of study, called a cohort study, looks at populations that have different exposures to a particular factor, such as formaldehyde. A cohort is a group of people who are followed over time to see whether a disease develops. Another kind of study, a case-control study, begins with people diagnosed as having a disease (cases) and compares them to people without the disease (controls).

Several NCI studies have found that anatomists and embalmers, professions with potential exposure to formaldehyde, are at an increased risk for leukemia and brain cancer compared with the general population. In 2003, a number of cohort studies were completed among workers exposed to formaldehyde. One study, conducted by the NCI, analyzed 25,619 workers in formaldehyde industries and estimated each worker's exposure to formaldehyde while at work.¹⁰ The analysis found an increased risk of death due to leukemia, particularly myeloid leukemia, among the workers exposed to formaldehyde. This risk was associated with increasing peak and average levels of exposure and the duration of exposure, but not cumulative exposure. Another study of 14,014 textile workers performed by the National Institute for Occupational Safety and Health (NIOSH) also found an association between the duration of exposure to formaldehyde and leukemia deaths. However, an additional cohort study of 11,039 British industry workers found no association between cumulative formaldehyde exposure and leukemia deaths.

Formaldehyde undergoes rapid chemical changes immediately after absorption. Therefore, some scientists think effects of formaldehyde at sites other than the upper respiratory tract are unlikely. However, some laboratory studies suggest that formaldehyde may affect the lymphatic and blood systems. Based on both the epidemiologic data from cohort studies and the experimental data from laboratory research, NCI investigators have concluded that exposure to formaldehyde may cause leukemia, particularly myeloid leukemia, in humans. However, inconsistent results from other studies suggest that further research is needed before definite conclusions are drawn.¹⁰

Several case-control studies and cohort studies, including analysis of the large NCI cohort, have reported an association between formaldehyde exposure and nasopharyngeal cancer, although others have not. Data from extended follow-up of the NCI study found that the excess of nasopharyngeal cancer observed in the earlier report persisted¹⁰.

Earlier analysis of the NCI cohort found increased lung cancer deaths among industrial workers compared with the general U.S. population. However, the rate of lung cancer deaths did not increase with higher levels of formaldehyde exposure. This observation led the researchers to conclude that factors other than formaldehyde exposure might have

caused the increased deaths. New data on lung cancer from the extended follow-up did not find any relationship between formaldehyde exposure and lung cancer mortality.

In addition, in a study of immune response in subjects exposed to formaldehyde in mobile homes, significant changes in immune system antibodies was found.¹¹

7. Hypersensitive Individuals Health Effects

Types of People More Susceptible - The very young (children, infants), the elderly, those with respiratory, skin and other chronic diseases are much more susceptible to the effects of formaldehyde. These individuals experience adverse symptoms at much lower concentrations than those that would affect the general/workplace population of normal, healthy adults.

Pre-existing conditions are exacerbated by formaldehyde exposure, especially respiratory ailments, including asthma, emphysema, and chronic bronchitis and skin allergies.

The symptoms of sinus irritation, sore throat, coughing, and nasal irritation from formaldehyde exposures also cause individuals to be much more susceptible to colds and other respiratory diseases caused by microbial exposures. This increased incidence is especially prevalent in individuals with compromised immune systems and pre-existing respiratory disorders.

Sensitization – includes changes in nasal cells – makes the susceptible individual more sensitive to the respiratory irritating effects of other organics, molds, and other airborne contaminants, and more susceptible to carcinomas of the nasopharynx. Skin sensitization results in allergy-induced skin rashes and dermatitis.

8. Formaldehyde Exposure in Travel Trailers and Various Occupations

According to a 1997 report by the U.S. Consumer Product Safety Commission, formaldehyde is normally present in both indoor and outdoor air at low levels, usually less than 0.03 parts of formaldehyde per million parts of air (ppm). Materials containing formaldehyde can release formaldehyde gas or vapor into the air. Formaldehyde can also be released by burning wood, kerosene, natural gas, or cigarettes; through automobile emissions; or from natural processes. Pressed wood products containing formaldehyde resins are usually the most significant source of formaldehyde in travel trailer homes.

Industrial workers who produce formaldehyde or formaldehyde-containing products, laboratory technicians, health care professionals, and mortuary employees may be exposed to higher levels of formaldehyde than the general public. Exposure occurs primarily by inhaling formaldehyde gas or vapor from the air or by absorbing liquids containing formaldehyde through the skin.

9. HUD Rule Changes

The HUD standard (see above) places limits on formaldehyde emissions and product certification of all plywood and particleboard materials, which involves emission certification by a nationally recognized testing laboratory and a written quality control

plan for each plant where particle board is produced or finished or where the plywood is finished. These standards have been required by HUD for manufactured homes, and now FEMA has incorporated those same standards in its manufacturing specifications for travel trailers. The HUD standards also require that each manufactured home be provided with a Health Notice on formaldehyde emissions as required by section 3280.309 of the Standards.

10. FEMA Formaldehyde Sampling of Travel Trailers

In July 2006, FEMA developed and implemented an air monitoring and sampling plan to establish and verify methods to reduce the presence of formaldehyde fumes in travel trailers. The sampling was conducted by the Environmental Protection Agency (EPA) and the data were analyzed by the ATSDR (Agency for Toxic Substances and Disease Register), which is affiliated with the Centers for Disease Control, at the U.S. Department of Health and Human Services (HHS).

The results of this study showed high levels of formaldehyde in nearly all of the trailers, whether they were continuously ventilated or were kept cool through air conditioning.

Without giving any explanation, **although the ATSDR has an exposure limit of 0.008 ppm for exposures of 365 or more days, rather than use this limit when analyzing EPA's air sampling of FEMA's trailers, the ATSDR arbitrarily chose a limit of 0.3 ppm as their "level of concern" and applied *this* high level to the results as if it were a safe and applicable exposure limit.**

This level is nearly 400 times the ATSDR's limit for people exposed more than 365 days, as the hurricane victims living in travel trailers are, and resulted in a bizarre skewing of the sampling results interpretation. However, even applying this "level of concern," the average sampling results were even higher than this very elevated level.

This misapplication and skewing of scientific results is at best unethical and grossly misrepresents and attempt to minimize the adverse health effects being experienced by thousands of travel trailer residents.

11. What Congress Should Do

Glues and adhesives that do not use formaldehyde and use soy products instead are readily available. These add very little cost to the manufacture of travel trailers, especially when considering the relative costs of medical treatment and the potential liability incurred by providing inferior and unsafe public housing.

Long term, the best solution is placing Katrina victims currently utilizing FEMA trailers into permanent housing. We need to help these victims return to normal lives. Thousands of families with 3,4,5 or more members are living in these small trailers. This amount of people taking showers and simply living in such cramped space causes mold formation and other additional adverse health impacts.

Short term, merely replacing trailers of those families that complain is not nearly protective enough. The average odor threshold for formaldehyde is 0.83 ppm, with few people being able to detect formaldehyde at levels lower than 0.5 ppm. Therefore, thousands of people may be overexposed and having their health compromised, especially individuals that are elderly and small children who are not aware of the hazard. FEMA needs to test and assure all trailers have safe formaldehyde indoor air concentrations immediately, then relocate *without delay* people living in trailers with levels above 0.05 ppm. Also, trailers must not be sold or donated to Native Americans or others without this testing being done to assure safe air quality.

In addition, FEMA needs to review and implement as necessary additional US Government procurement specifications for travel trailers purchased, to include "baking off" procedures by the manufacturers and parts suppliers. This would allow formaldehyde to cure and off-gas at the manufacturing level rather than once occupied.

An additional necessary action item includes assuring all *new* trailers have safe formaldehyde indoor air concentrations. Clearance sampling (testing the formaldehyde level in each trailer prior to acceptance/delivery) must be done. If a trailer is found to be above standard it poses a potential health concern to its occupants and FEMA should not accept delivery of the trailer.

Lastly, FEMA needs to educate trailer occupants of formaldehyde health effects and give them options for relocation.

Bibliography and References

¹ "03/13/1998 - OSHA rulemaking on formaldehyde exposure limits", Standard Interpretations, United States Department of Labor, at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=22543, 13 March 98.

² "Manufactured Home Construction and Safety Standards: Formaldehyde emission standards and controls", United States Department of Housing and Urban Development, § 3280.308, Formaldehyde Emissions Controls for certain wood products at http://a257.g.akamaitech.net/7/257/2422/04nov20031500/edocket.access.gpo.gov/cfr_2001/aprqr/pdf/24cfr3280.308.pdf, 1993.

³ Formaldehyde – U.S EPA Fact Sheet 50-00-0; created in April, 1992, rev. January, 2000.

⁴ <http://www.dshs.state.tx.us/iaq/rules.shtm>

⁵ <http://www.cdc.gov/niosh/npg/npgd0293.html>

⁶ <http://www.acgih.org>

^{7,8} http://www.euro.who.int/document/aiq/5_8formaldehyde.pdf

⁹ “Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants,” Subcommittee on Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants, Committee on Toxicology, National Research Council Subcommittee on Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants, ISBN: 0-309-10661-3, 316 pages, 6 x 9, (2007).

¹⁰ “Formaldehyde and Cancer: Questions and Answers”, United States Institutes of Health National Cancer Institute at <http://www.cancer.gov/cancertopics/factsheet/Risk/formaldehyde>, 30 July 04.

¹¹ Thrasher, Jack D. et. al., “Evidence for Formaldehyde Antibodies and Altered Cellular Immunity in Subjects Exposed to Formaldehyde in Mobile Homes,” Archives of Environmental Health, Vol. 42, pp. 347-350, 1987.

DeVany, Mary C., MS, CSP, CHMM, “Summary of Formaldehyde Health Effects and Exposures in FEMA Travel Trailers” 10 May 2007 Statement for Press Conference, DeVany Industrial Consultants, Vancouver, Washington, May 2007.

FNF-07-028, “FEMA Actions to Minimize Formaldehyde in Travel Trailers”, at <http://www.fema.gov/news/newsrelease.fema?id=36730>, 4 June 07

Gillette, Becky, “Testimony to House Comm. on Oversight and Government Reform”, U.S. House of Representatives, 19 July 07.
