

**California Department of Health Services**  
**SENSOR/EPA Occupational Pesticide Poisoning Prevention Project**  
**Field Investigation Report**  
**(CA 001-99- June 21, 1999)**

**Pesticide Illness Due to Room Disinfection with  
Paraformaldehyde**

The Sentinel Event Notification of Occupational Risk (SENSOR) Pesticide Poisoning Prevention Project is conducted by the California Department of Health Services through the support of the National Institute for Occupational Safety and Health and the US Environmental Protection Agency. The goal of the SENSOR project is to prevent pesticide poisoning among workers. In California, physicians are required by law to report any illness or injury that might be related to the workplace. SENSOR staff utilize this physician-based reporting system to conduct state-wide surveillance of pesticide illness among workers. California's Poison Control Centers are an important source of timely physician reports. Selected cases are followed up by a workplace investigation and interviews with workers, employers, and others involved in the incident. The investigations assess factors that may have contributed to occupational illness and make recommendations to prevent pesticide-poisoning among workers.

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## Summary

A worker at a small cell biology research company set up a procedure to disinfect the cell culture room to eliminate molds. The procedure involved heating paraformaldehyde (a white powder), which caused formaldehyde gas to be released into the room. At about 7 p.m., the worker closed the door and window between the cell culture room and the adjoining laboratory, placed a sign which read "Do Not Enter, Room Sterilization In Progress" on the door to the cell culture room, and left the workplace.

Shortly thereafter, a researcher who was working alone at a computer in the laboratory near the door to the cell culture room detected a funny skin sensation, followed by nausea and vomiting. The worker went to the bathroom, and upon opening the door to return to the laboratory, the worker noticed a strong, pungent odor. The worker sought a co-worker's assistance. The co-worker went into the laboratory, detected a strong smell, and left the laboratory. The co-worker then went back into the laboratory. In the laboratory the co-worker found and donned a full-face respirator and entered the cell culture room. A short time later, both workers left the building.

When paraformaldehyde is heated, formaldehyde gas is released into the air. Breathing in this air can be extremely irritating to skin, eyes and mucus membranes of the upper respiratory tract, and can cause nausea and vomiting. Exposure can cause allergic respiratory and skin reactions, and pulmonary edema. The two exposed workers experienced one or more of the following symptoms: nausea, vomiting, headache, anxiety, throat irritation, cough, odor, eye irritation and tearing. As of the time of this writing one worker's cough has persisted for two months. According to the

National Institute for Occupational Safety and Health's pesticide-illness case classification criteria, exposure to paraformaldehyde in this workplace resulted in one probable and one possible case of pesticide-related illness.

### **How could this pesticide-poisoning have been prevented?**

- The exposure control measures specified in the written protocol were inadequate to ensure the health and safety of workers. The paraformaldehyde exposure of the first worker could have been prevented had access to the workplace during the procedure been effectively restricted and had containment of formaldehyde gas in the cell culture room been routinely monitored. The exposure of the second worker could have been prevented by training workers how to respond to an emergency.
- Paraformaldehyde was used as a pesticide but the product was not registered for this use. The use of a registered product could have prevented this incident because registration would require that the product label specify conditions of safe use (presumably including restricted access, monitoring of containment, worker training and other appropriate control measures). Implementation of these label specifications would be enforceable by law.

### **Background**

On March 19, 1999 the San Francisco Poison Control Center reported a worker with paraformaldehyde exposure to the California Department of Health Services, Sentinel Event Notification of Occupational Risk (SENSOR) Pesticide Poisoning Prevention Project. A physician and industrial hygienist from the SENSOR project conducted two on-site investigations (April 12 and April 19, 1999) at the cell biology research company where the incident occurred. SENSOR staff: (1) interviewed the company President, the Safety Officer, a Research Scientist, the index case, and two other employees; (2) reviewed written training records and operating procedures; and (3) observed the physical layout of the workplace. Cal-OSHA and the county Department of Agriculture also investigated this incident. Cal-OSHA issued multiple citations related to the use of formaldehyde. The county Department of Agriculture sent the employer a letter explaining pesticide use laws and regulations and training and documentation forms.

### **Incident**

The incident occurred at a cell biology research firm with 11 employees. Late in the afternoon of March 19, 1999, a worker set up a procedure to disinfect the cell culture room to eliminate molds. The cell culture room adjoined the laboratory and there was a door and a window between the two rooms (Figure 1). There was no mechanical ventilation in the building and the fan in the Class II biosafety cabinet in the cell culture room was turned off. The procedure involved heating paraformaldehyde (a white powder), which caused formaldehyde gas to be released into the room. The gas was later neutralized with ammonium bicarbonate.

The worker measured out approximately 200 ml of paraformaldehyde and 350 ml of ammonium bicarbonate into separate glass beakers and placed them on two heating plates in the cell culture room which is approximately 2172 ft<sup>3</sup>. The beaker of paraformaldehyde was on one heating plate and the timer was set to begin heating the chemical at approximately 7:30 p.m. The ammonium bicarbonate was placed on the other heating plate and the timer was set to start heating approximately six hours later. At about 7 p.m. the worker closed the door and window of the cell culture room and placed a sign which read "Do Not Enter, Room Sterilization In Progress" on the door to the cell culture room and left the workplace.

Shortly thereafter, a researcher who was working alone at a computer in the laboratory near the door to the cell culture room detected a funny skin sensation, followed by nausea and vomiting. The worker went to the bathroom outside the laboratory, and upon opening the door to return to the laboratory, the worker noticed a strong, pungent odor. The worker left the building, noticed one co-worker's car remained in the parking lot, reentered the building and sought the co-worker's assistance. The co-worker went into the laboratory, detected a strong smell, and left the laboratory. The co-worker then went back into the laboratory. Inside the laboratory the co-worker found and donned a full-face respirator and entered the cell culture room. The co-worker observed that the window between the laboratory and the cell culture room was closed and left. A short time later, both workers left the building. One worker sought medical care at a local hospital emergency room that evening. The other worker did not seek medical attention.

The exposed workers experienced one or more of the following symptoms: nausea, vomiting, headache, anxiety, throat irritation, cough, odor, eye irritation and tearing. As of the time of this writing one worker's cough has persisted for two months. According to the National Institute for Occupational Safety and Health's pesticide-illness case classification criteria, the two workers exposed to paraformaldehyde in this incident represent one probable and one possible case of pesticide illness.

## Prevention Strategies

Employers should attempt to make work tasks as safe as possible. Heating paraformaldehyde to disinfect a room is an inherently hazardous procedure. When paraformaldehyde is heated, formaldehyde gas is released into the air. Breathing in this air can be extremely irritating to the eyes, skin and mucus membranes of the upper respiratory tract and can cause nausea and vomiting. Exposure can cause allergic respiratory and skin reactions, and pulmonary edema. The effects of exposure may be delayed. Exposure to paraformaldehyde may cause cancer and heritable genetic damage. Formaldehyde is classified by the US Environmental Protection Agency as a group B1, probable human carcinogen of medium carcinogenic hazard.

- Safer alternatives to hazardous work processes should be implemented when available. In this incident, SENSOR staff could not determine if mold contamination of the cell culture room could have been prevented in the first place, or, if the room could have been disinfected using a less hazardous method.
- If a hazardous work process cannot be eliminated, effective exposure control measures must be developed and implemented. In this incident, the exposure control measures specified in the written protocol were inadequate to ensure the health and safety of the workers.

1. The protocol stated that the paraformaldehyde disinfection process would occur at night or during the weekend, and that a warning sign be placed on the cell culture room door. These conditions alone did not specifically prohibit employee access to the adjacent laboratory or other areas of the workplace during the procedure. The paraformaldehyde exposure of the first worker could have been prevented, had access to the workplace during the procedure been effectively restricted.

2. The protocol stated that the window and door between the cell culture room and the laboratory be closed. These conditions alone did not ensure that formaldehyde gas would be contained in the cell culture room. Several variable and unpredictable factors may have influenced the direction of air flow between the cell culture room and the laboratory, such as the weather, a broken

floor tile near the door which may have allowed formaldehyde gas to flow under the door, and open window(s) in the laboratory. No air monitoring was conducted in the laboratory to ensure that formaldehyde remained in the cell culture room during the procedure.

3. The protocol stated that at the end of the procedure, entry to the cell culture room could be done safely with a "fume mask with the appropriate filters" to open the window to the laboratory and turn on the exhaust fan. However, comprehensive training and fit testing, as required by the Cal-OSHA respirator standard CCR Title 8, GISO 5144 for persons required to wear a respirator, were not provided.

- Employers must train workers about health and safety hazards on the job. In this incident, laboratory workers who routinely worked with or around hazardous chemicals did not know how to respond to an emergency situation. The exposure of the second worker could have been prevented by such training.
- Paraformaldehyde, if used as a disinfectant, is required to be registered as a pesticide (1988 EPA FIFRA pesticide subject to regulation). In this incident, paraformaldehyde was used as a pesticide but it was not registered for this use. The use of a registered product could have prevented this incident because registration would require that the product label specify conditions of safe use (presumably including restricted access, monitoring of containment, worker training and other appropriate control measures). Implementation of these label specifications would be enforceable by law. To date, SENSOR staff have been unable to determine how widely this room disinfection procedure may be in use. However, SENSOR staff have learned from federal and state health officials that heating paraformaldehyde to disinfect biological safety cabinets is a standard procedure that has been in use for many years.

The California Department of Pesticide Regulation is responsible for enforcement of the laws governing the use of pesticides in California. The law is enforced on the county level by the county Department of Agriculture. SENSOR staff will continue to assess the scope of the problem to support the efforts of local and state regulatory agencies. The employer reportedly ceased using the procedure after the incident. The index case was fired six weeks after the incident occurred.

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