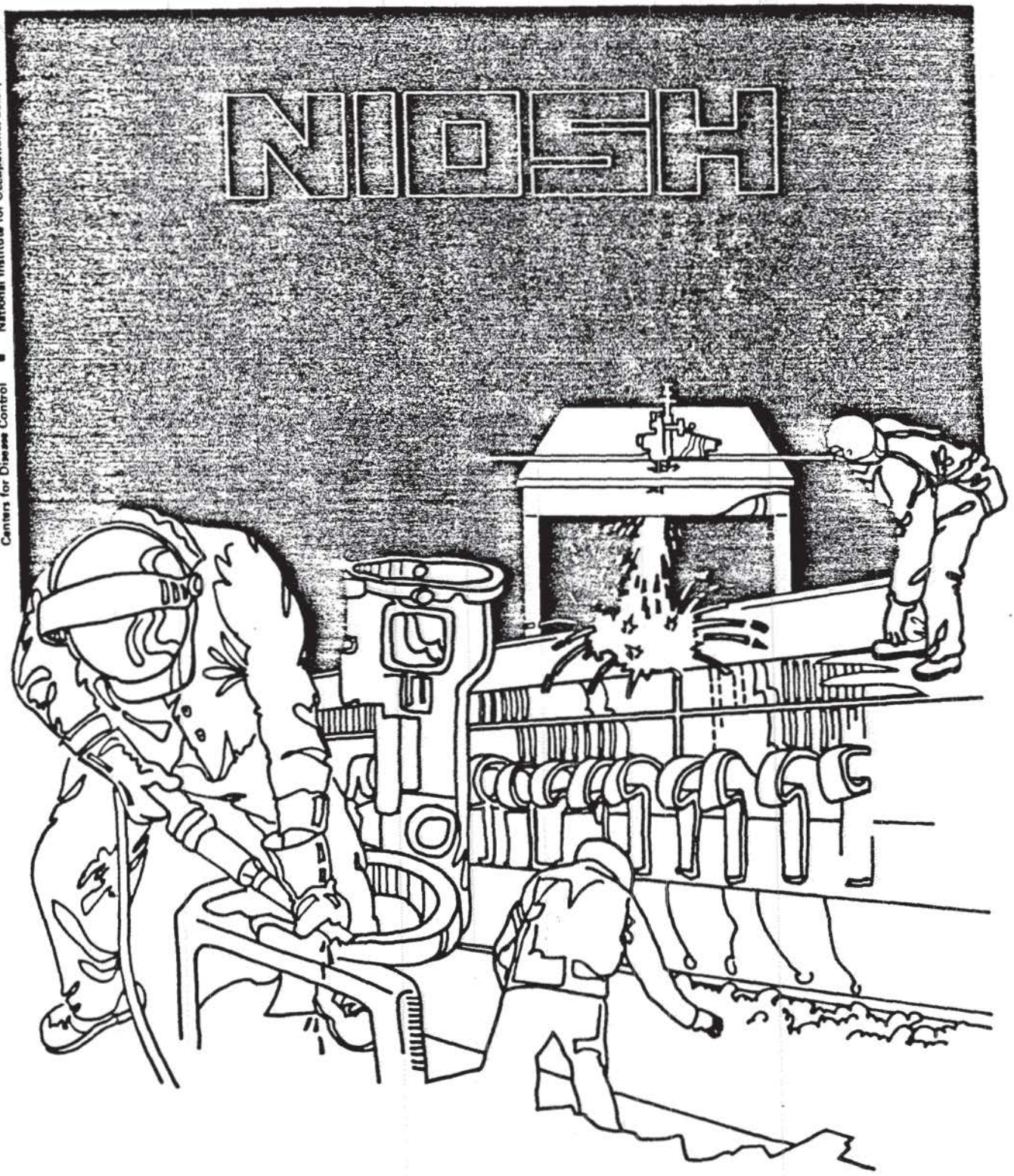
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 81-241-970
NATIONAL PARK SERVICE
PATCHOGUE, NEW YORK

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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NIOSH Investigator:
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I. SUMMARY

In February, 1981, the Regional Safety Manager of the United States Department of the Interior requested that the National Institute for Occupational Safety and Health (NIOSH) determine if formaldehyde vapors were present in two houses located at Watch Hill, Fire Island. The buildings are owned by the National Park Service and are used to house Park Service Rangers and their families. In February, 1977, urea-formaldehyde (UF) foam insulation was installed in the houses. Since then, the residents of the houses have complained intermittently of eye and nose irritation and respiratory problems (prolonged colds and bronchitis).

On February 27, 1981 a representative of NIOSH collected samples using commercially available sorbent tubes specific for formaldehyde as the sampling media. Minimum formaldehyde concentrations were determined to be less than 0.1 milligram per cubic meter of air (mg/M^3) in House #1 and 0.1 to 0.2 mg/M^3 in house #3. Formaldehyde concentrations were essentially unchanged three weeks after the insulation was removed from house #3. The Occupational Safety and Health Administration (OSHA) has established a Permissible Exposure Limit, for formaldehyde in an occupational setting, of 4.5 mg/M^3, as a time weighted average for an 8 hour work-day, 40 hour work-week; and a ceiling level of 7.5 mg/M^3. NIOSH recommends that exposures to formaldehyde in an occupational setting be limited to 1.2 mg/M^3 as a ceiling limit for 30 minutes, to reduce irritative effects. A recent NIOSH Current Intelligence Bulletin recommends that formaldehyde be handled as a potential carcinogen, and that exposures to formaldehyde be kept at a minimum.

It is difficult to relate these standards, designed to limit occupational exposure, to this situation where the exposures are to very small concentrations for a prolonged duration. Nevertheless, since the occupants of the houses, including minors, have exhibited symptoms compatible with those of formaldehyde exposure, NIOSH recommends that the National Park Service take action to limit or eliminate exposures. These actions might include: (1) restricting the use of the houses to the summer months when increased natural ventilation and increased out-door activity would limit exposures, (2) removal of the urea-formaldehyde insulation with prolonged ventilation of the houses, and/or (3) repair of the houses to prevent formaldehyde vapors from entering the living quarters. These repairs might include caulking of walls and corners where the insulation is visible and sealing wallboards and panelling with an epoxy resin-based paint.

KEYWORDS: SIC 9512 (Land, Mineral, Wildlife and Forest Conservation), formaldehyde, private homes.

II. Introduction

The Regional Safety Manager of the United States Department of Interior telephoned the Region II NIOSH Office in early February, 1981, requesting technical assistance. The Safety Manager requested that NIOSH determine if formaldehyde vapors were present in two buildings which the National Park Service uses to house Park Rangers and their families at the Watch Hill area of the Fire Island National Seashore, New York.

III. Background

The National Park Service is in charge of the Fire Island National Seashore on Fire Island, off the southern coast of Long Island, New York. In the Watch Hill area of the island, the National Park Service uses five houses, built in the 1950's, to house park rangers and their families. Two of the houses (#1 and #3) were insulated with urea-formaldehyde (UF) foam in February, 1977. Both houses are of wood-frame construction with the insulation foamed-in-place between the exterior and interior walls. The insulation was visible through joints of the wood panelling in some areas of both houses. The insulation has deteriorated and crumbles upon handling. The only other obvious sources of formaldehyde are wood-burning stoves which were installed in each house before the Winter of 1980-81. Building #1 is smaller and houses a ranger, his wife and infant son. Building #3 houses a ranger, his wife and 3 school-aged children. During Winter, the area is almost uninhabited. The nearest occupied private home is several miles away. There are no paved roads. Transportation is achieved by four wheeled vehicles and by boat to the mainland. Because of the isolation, much time is spent indoors in the Winter. The Regional Safety Manager of the U.S. Dept. of Interior, acting upon complaints of the occupants (eye, nose, and throat irritation, prolonged colds and bronchitis) and with a general concern based on reports of similar symptoms among occupants of other buildings which had been insulated with UF foams, asked NIOSH to determine if formaldehyde vapors were present in the two houses.

Exposure to formaldehyde vapor inside dwellings has been identified as a cause of eye and nose irritation, breathing difficulties, headaches, sinusitis, etc. UF foam insulation releases formaldehyde as it cures (hardens) after installation. The amount of formaldehyde released and the length of time of release of formaldehyde are variable. It is known that the rate of release of formaldehyde diminishes with time. The curing process may require as long as three years. Also, UF foam insulation may produce formaldehyde vapor as a result of improper installation. Some examples of the parameters which may produce an immediate release of formaldehyde are: improper mixing of the resin mixture, uneven placement of the mixture between walls, use of out-dated resins, use of excessive formaldehyde to force the polymerization reaction to completion, moisture trapped between the walls, and installation of the foam at ambient temperatures less than 50°F or greater than 80°F. After installation,

a combination of elevated temperature and high humidity may result in spontaneous breakdown of UF foam with the possible release of formaldehyde[1]. In addition, wood construction beams and panelling may be saturated with formaldehyde and act as secondary sources of release of formaldehyde vapor, even after the UF foam insulation has been removed.

The installation of the UF foam was done in February, 1977, when the temperature probably was less than 50°F. Reportedly, it was a poor installation job, with gaps between areas of the insulation. The UF foam has deteriorated, indicating improper mixing or use of outdated materials. Staining of the interior surfaces of the walls and of the wooden beams was observed upon removal of the UF foam, indicating that formaldehyde may have been absorbed into the wood. If this has occurred, the contaminated wood in the house may continue to out-gas formaldehyde vapors for an undetermined period of time.

IV. Sampling and Evaluation

Sampling

On February 27, 1981, samples were collected in the living rooms and master bedrooms of the two houses. Air was drawn through commercially available sampling tubes (Formaldehyde Sorbent, Lot 124, SKC, Inc.) for about four hours. The outside weather was fair, temperature approximately 50°F. All windows, doors and other openings were closed. The wood-burning stoves were not in operation at the time of the survey.

The samples were analyzed using a modification of NIOSH's Method P&CAM 318 (ion chromatography). Small concentrations of formaldehyde were found in both houses (Less than 0.1 mg/M^3 in house #1 and 0.1 to 0.2 mg/M^3 in house #3). The National Park Service was informed of the concentrations of formaldehyde present in the two houses and elected to move the families to other near-by houses which were not insulated with UF foam. Between February and early May, the UF foam was removed from house #3 and a resurvey of the house was requested. The resurvey of house #3 in late May, performed with doors and windows closed and outdood temperature in the mid 60°F range, revealed formaldehyde concentrations ranging from 0.10 to 0.19 mg/M^3. The results of the surveys are listed in Table I.

In October, 1981, NIOSH determined that the sampling and analytical methods used in this study were suspect, and that samples collected and/or stored at temperatures above 40°F may contain up to twice as much formaldehyde as was reported. It is impossible to determine exactly to what degree any sample may have been affected by temperature. Therefore, the concentrations of formaldehyde reported in this study must be considered to be minimum values and that the actual concentrations of formaldehyde may be as much as 100% greater. For example, a concentration reported as 0.1 mg/M^3 may in reality be 0.2 mg/M^3.

Because the concentrations of formaldehyde were so small, this development has little bearing on the evaluation of the situation of the Watch Hill houses or on the recommendations made.

Evaluation

In its 1976 Criteria Document, NIOSH recommended that exposure to formaldehyde in an industrial situation be controlled so that exposure not exceed 1.2 mg/M^3 (0.8 parts per million parts of air-ppm) during any 30 minute period, and that exposures be less during the remainder of the work day[2]. This type of limit is known as a ceiling value, and was established mainly to prevent eye and mucous membrane irritation. The Occupational Safety and Health Administration (OSHA) standard is 3 ppm (approximately 4.5 mg/M^3) for an 8-hour work day, 40-hour work week. This type of limit is known as a time-weighted average. OSHA also has set a ceiling value of 5 ppm (7.5 mg/M^3), and an acceptable maximum peak of 10 ppm (15 mg/M^3) for no more than 30 minutes.[3] These limits were intended to relate to a work situation with a daily exposure time of 8 or 10 hours, and were not meant to apply for longer periods such as occur in homes, or to apply to children. The effects of long term exposure to very small concentrations of formaldehyde are not known.

The Netherlands has established an "In Home Limit" for exposure to formaldehyde of 0.15 mg/M^3. Sweden, Denmark and West Germany have proposed similar limits[4]. In addition, a recent (April, 1981) NIOSH Current Intelligence Bulletin recommends that exposure to formaldehyde be reduced to the "lowest feasible limit", based on studies which indicate that formaldehyde may be a potential carcinogen[5].

In NIOSH's evaluation of this situation, the following factors were considered.

1. Symptoms compatible with formaldehyde exposure were experienced by the occupants of the houses.

2. Formaldehyde vapor was detected in both houses.

3. The symptoms of the occupants of the houses abated during prolonged absences (several weeks or more) from the houses.

4. The occupants of the houses include children, at ages susceptible to respiratory illnesses. At least one report claims that infants are particularly affected by exposure to formaldehyde in the home[6].

5. The occupants are indoors, especially during Winter, for more than 8 hours daily.

V. Recommendations

Based on the above evaluation, NIOSH recommends that the National Park Service reduce or eliminate exposure to formaldehyde in houses #1 and #3 at Watch Hill, Fire Island. The optimum method to achieve this would be the

removal of the urea-formaldehyde foam and/or repair of the buildings to limit seepage of formaldehyde vapors into the living quarters. If, as suspected, formaldehyde has saturated integral wooden parts of the buildings, extensive ventilation of the houses may be necessary. If the reduction or elimination of formaldehyde vapor approximately to background, naturally occurring levels cannot be achieved, consideration should be given to limiting occupancy to adult rangers in summer months when natural ventilation would be at the maximum.

VI. REFERENCES

1. Interim Report of the NHW Advisory Committee on Urea Formaldehyde Foam Insulation, University of Ottawa, Ottawa, Canada, December 8,1980.

2. National Institute for Occupational Safety and Health: Criteria for a Recommended Standard...Occupational Exposure to Formaldehyde. DHEW (NIOSH) Publication No. 77-126 (1976).

3. Occupational Safety and Health Administration: General Industry OSHA Safety and Health Standards (29 CFR 1910). OSHA Publication 2206, Washington, D.C., p.554 (Revised November 7, 1978).

4. U.S. National Academy of Sciences, Committee on Toxicology. Formaldehyde--An Assessment of its Health Effects. Washington, D. C., March, 1980.

5. Current Intelligence Bulletin 34. DHHS (NIOSH) Publication No. 81-111 April 15, 1981

6. Woodbury, M. A. An Assessment of the Odor Problems from UF Foam Insulations. Wisconsin Department of Health and Social Services. December 1, 1978.

VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Originating Office	Hazard Evaluation and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies

VIII. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report currently are available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Va. 22151. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address

Copies of this report have been sent to:

1. The National Park Service, Patchogue, N.Y.
2. Regional Safety Manager, U.S. Dept. of Interior, Boston, Mass.
3. U.S. Dept. of Labor, OSHA, Region II, N.Y., N.Y.
4. U.S. Dept. of Health and Human Services, NIOSH, Region II, N.Y., N.Y.
5. N.Y. State Dept. of Health, Albany, N.Y.

Table I

NATIONAL PARK SERVICE
Fire Island, N. Y.
Formaldehyde Concentrations

LOCATION	FORMALDEHYDE CONCENTRATIONS milligrams/cubic meter	
	2/81	5/81
House #1,Bedroom	0.07	
House #1,Dining Area	0.09	
House #3, Living Room	0.19	0.18 0.10
House #3, Master Bed Room	0.12	0.18
House #3, Left Bed Room		0.19
House #3, Right Bed Room		0.09
Outdoor Air		N.D.

N.D. = None Detected. Limit of detection is approximately 0.02 milligram per cubic meter of air.

In October, 1981, NIOSH determined that the sampling and analytical methods used in this evaluation may have been affected by temperatures above 40°F. Accordingly, the above values must be considered to be minimum. Actual concentrations of formaldehyde may be as much as twice these values.