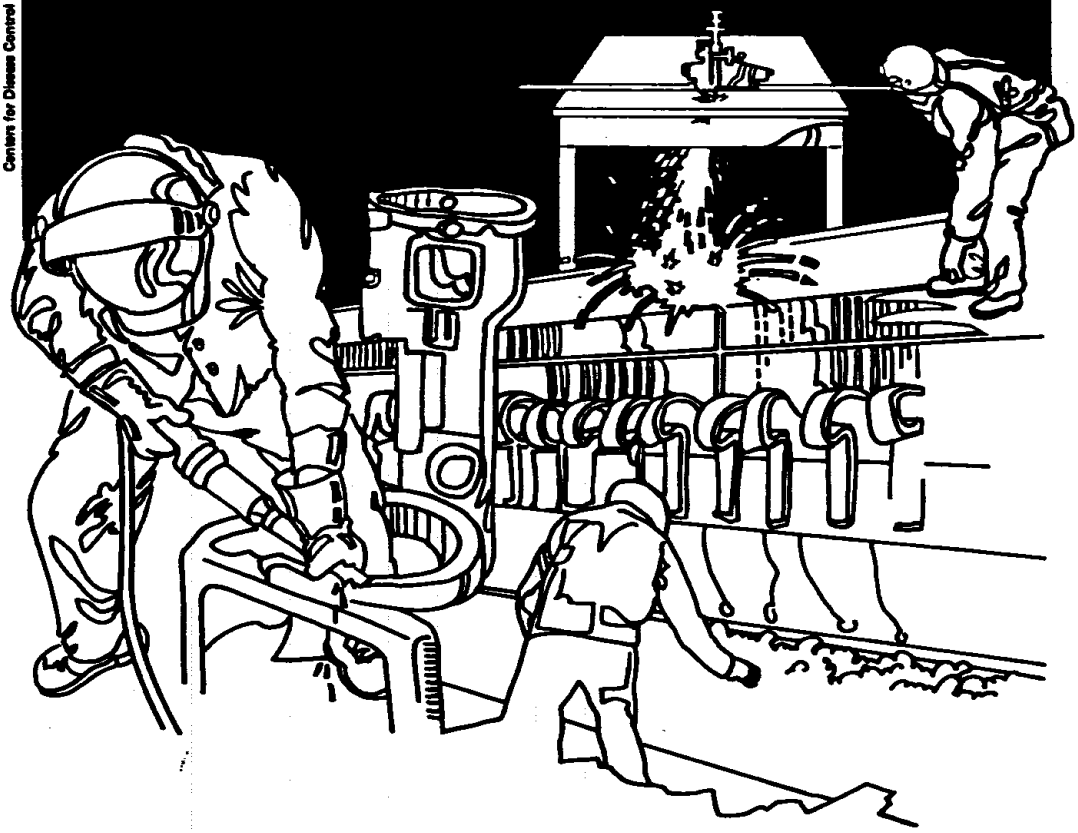
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

RDHETA 90-145-2086
MAP INTERNATIONAL
FAIRMONT, WEST VIRGINIA

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 and 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.

RDHETA 90-145-2086
NOVEMBER 1990
MAP INTERNATIONAL
FAIRMONT, WEST VIRGINIA

NIOSH INVESTIGATOR:
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I. SUMMARY

In February 1990, the Division of Respiratory Disease Studies (DRDS), National Institute for Occupational Safety and Health (NIOSH) received a request from the International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America to conduct a Health Hazard Evaluation at MAP International in Fairmont, West Virginia. MAP International manufactures fibrous glass for thermal and acoustical insulation. Potential exposures which were identified in the request were fibrous glass and formaldehyde.

NIOSH investigators conducted an initial site visit and walk-through inspection on February 21, 1990. On May 2, 1990, work practices were observed and environmental sampling was conducted. On April 26 and 27, 1990, all currently employed and laid-off workers were given the opportunity to complete a medical questionnaire.

Personal breathing zone and area air samples were collected to characterize employees' exposure to fibrous glass, formaldehyde, phenol, ammonia, and organic vapors. Airborne formaldehyde exposures ranged from 0.07 to 0.41 parts per million (ppm). The validity of the 0.41 ppm result is questionable when compared to all other personal and area sample results. Only a trace amount of phenol was detected on any of the samples. Respirable fibrous glass concentrations ranged from less than 0.01 to 0.07 fibers per cubic centimeter. The ammonia concentrations measured (0.6 ppm to 3.6 ppm) were well below the evaluation criteria. The sampling for organic vapors indicated the presence of toluene, C_8 to C_{11} hydrocarbons, and C_{16} alkane; but in amounts too small to quantify.

Workers were not following the health and safety procedures prescribed in the material Safety Data Sheets for the materials used and manufactured in the plant. Also, the workers were observed not wearing the appropriate work clothes and personal protective equipment prescribed in the company's written safety procedures.

Fifty-one (53%) of the eligible workers completed the medical questionnaire. The workers reported symptoms consistent with exposure to fibrous glass and the materials used in its production. Fifty to sixty percent of the participants complained of eye irritation, upper respiratory irritation, skin irritation, chronic cough, and shortness of breath.

The airborne levels of formaldehyde, ammonia, organic vapors, phenol, and respirable fibrous glass measured at the time of the survey were well below the Occupational Safety and Health Administration Permissible Exposure Levels (PEL). Exposures to formaldehyde, although well below the OSHA PEL, were above the NIOSH Recommended Exposure Level. Levels of contaminants measured did not appear to be high enough to account for the high prevalence of symptoms reported. The poor work practices observed appear to be the major contributing factor for the prevalence of eye and skin irritation complaints. Recommendations for reducing potential exposures are included in this report.

Keywords: SIC Code: 3296 (fibrous glass manufacturing), formaldehyde, fibrous glass, ammonia.

II. INTRODUCTION

In February 1990, the Division of Respiratory Disease Studies (DRDS) of the National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized employee representative of the Teamsters Union to conduct a Health Hazard Evaluation (HHE) at MAP International in Fairmont, West Virginia. The request stated that employees were experiencing nose bleeds, skin rashes, and respiratory problems. Potential exposures identified in the request were fibrous glass and formaldehyde.

On February 21, 1990, a NIOSH industrial hygienist made an initial site visit to the MAP facility. The NIOSH representative discussed the request and plans for the ensuing evaluation with the company and union representatives and conducted a walk-through inspection of the plant.

On April 26 and 27, and May 2, 1990, a medical and environmental survey was conducted. The medical portion of the survey consisted of administering a questionnaire to determine types and prevalence of worker health complaints. The environmental portion of the survey consisted of observing work practices, collecting personal breathing zone and area air samples to determine worker exposure to respirable fibrous glass, formaldehyde, phenol, ammonia, and organic vapors.

III. PROCESS DESCRIPTION

The fibrous glass manufactured at MAP is primarily used for thermal and acoustical insulation. The process includes delivery and unloading of the raw materials (sand, limestone, soda ash, feldspar, borax), their transport to storage silos, and subsequent mixing to form the raw batch that is then transported by screw auger to the furnace for melting.

In the furnace, the batch is converted to a homogeneous mass of molten glass. The molten glass leaves the furnace after passing under a skimmer and through the throat, which is below the level of the molten glass. Connected to the throat is the forehearth which acts as a channel to move the glass into the fiberizers. The glass fiber is produced when the molten glass passes through the fiberizer. Directly under the fiberizers are cooling fins and a spray of water. The water spray is followed by a solution of phenolic resin binder (phenol, formaldehyde), urea, ammonium sulfate, petroleum emulsion, anhydrous ammonia, and carbon black.

The binder solution is sprayed on the fibers as they are collected on a conveyor belt. The binder solution coats the fibers for lubrication and protection of the fibers. It also provides for reinforcement and better bonding of the fibers, and gives them a specific handling characteristic. The mat of fibers is then wound onto a rotating cylinder. The rolled mat of fibers may then be removed for storage and drying. For some specific

products, additional drying may be necessary. If this is the case, the mat is not collected on the rotating cylinder but is passed through a drying oven before being cut.

At the time of our survey the drying oven was not operational. It had been shut down due to air pollution problems. MAP is waiting for an additional scrubber to be installed on the drying oven exhaust stack.

The mats of fiber glass, depending on how they are to be used, are either stored and shipped from this plant or are moved to the molding department. The molding department has three production lines where the mats are placed in molds and then into a heated press to form the desired item. The items formed on the sterling line are sprayed with a black fire resistant coating. The main ingredient in the coating is mineral spirits.

The plant has been operational since July 1988. It normally employs approximately 100 individuals (16 salary, 84 hourly). At the time of this survey, approximately 50 production workers were employed. The fibrous glass making department normally operates 7 days per week, two 12-hour shifts. At the time of our survey, they were operating two 12-hour shifts 3 days per week. The molding department which normally employs 20 workers per shift, three 8-hour shifts per day, 5 days per week was only operating one 8-hour shift per day 5 days per week.

IV. METHODS AND MATERIALS

A. Environmental

On May 2, 1990, work practices were observed and environmental samples were collected during the day shift in an attempt to evaluate the workers' exposure to fibrous glass, formaldehyde, phenol, ammonia, and organic vapors. Personal breathing zone air samples were obtained on the production workers in both the fibrous glass making department and the molding department. Area air samplers were also placed in both departments. Two sampling stations (one 100 yards upwind of the plant, one at the Teamsters Union Hall approximately 2 miles from the plant) were selected to obtain outside background levels for some of the substances sampled for inside the plant. The specific methods used in the sampling and analysis are presented below:

Formaldehyde

Full shift personal and area samples were collected on solid sorbent tubes (ORBO-23) using constant flow sampling pumps calibrated at 75 cubic centimeters per minute (cc/min). The samples were analyzed by gas chromatography with a flame ionization detector according to NIOSH analytical method 2541.[1]

Phenol

Full shift personal and area samples were collected per NIOSH Analytical Method 2001 (cresols).[2] Samples were collected using constant flow sampling pumps calibrated at 50 cc/min. The collection media was a solid sorbent tube (silica gel). The samples were analyzed by gas chromatography with a flame ionization detector.

Fibrous Glass

Personal and area samples were collected and analyzed per NIOSH Analytical Method 7400.[3] Full shift samples were collected using constant flow sampling pumps calibrated at 1 liter per minute (lpm) with an in-line 25 millimeter (mm) three-piece cassette with a 50 mm electrically-conductive extension cowl and cellulose ester filter, 0.8 μm pore size and back-up pad. Phase contrast microscopy was used to count fibers greater than 10 μm in length and less than 3.5 μm in diameter. Only the smaller diameter fibers (less than 3.5 μm) were counted because fibrous glass manufactured for acoustical insulation is generally smaller than 3 μm, and there is concern that exposure to fibrous glass having fiber dimensions (<3 μm) similar to those of asbestos fibers might lead to chronic respiratory effects.[4] The "B" counting rules were used because they are more appropriate for measurement of specific non-asbestos fiber types, such as fibrous glass.[3]

Ammonia

Personal time-weighted average (TWA) exposures were determined using passive dosimeters filled with a liquid sorbent (0.01 N H_2SO_4). The dosimeters were analyzed per NIOSH Analytical Method 6701 using ion chromatography with conductivity detection.[2]

Short-term (15 minutes) area air samples were collected using constant flow sampling pumps with an in-line midget impinger containing 10 milliliters (ml) of dilute sulfuric acid. Air was drawn through the impinger at a flow rate of 1 lpm. The samples were analyzed by ion chromatography with conductivity detection per NIOSH Analytical Method 6701.[2]

Organic Vapors

The organic vapor samples were collected on a solid charcoal media in a sorbent tube. These samples were collected using portable sampling pumps calibrated at 20 cc/min. Full shift personal and area samples were taken. Bulk airborne vapor samples were also collected on charcoal tubes. The bulk air samples were analyzed qualitatively for organic compounds by gas chromatography (GC) in conjunction with mass spectrometry (MS). The charcoal tube samples were then analyzed quantitatively by GC for those organic gases and vapors detected in the bulk samples.[2]

B. Medical

All 97 currently employed and laid off workers were given the opportunity to complete a medical questionnaire April 26 and 27, 1990 administered by NIOSH investigators. This included questions about symptoms occurring at work, chronic and acute respiratory symptoms, smoking habits, and skin problems.

V. EVALUATION CRITERIA AND TOXICOLOGY

A. Criteria

Evaluation criteria are used as guidelines to assess the potential health effects of occupational exposures to substances and conditions found in the work environment. These criteria are generally established at levels that can be tolerated by most healthy workers occupationally exposed up to 10 hours per day, 40 hours per week, for a working lifetime without adverse effects. Because of variation in individual susceptibility, a small percentage of workers may experience health problems or discomfort at exposure levels below these existing criteria. Consequently, it is important to understand that these evaluation criteria are guidelines, not absolute limits between safe and dangerous levels of exposure.

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects often are not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes and, thus, potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria considered in this report are: (1) NIOSH Criteria Documents and recommendations, (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and (3) the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standard [Permissible Exposure Limits (PEL's)]. The NIOSH recommendations and the current ACGIH TLV's are often lower than the corresponding OSHA standards. NIOSH Recommended Exposure Levels (REL's) and ACGIH TLV's are arrived at differently than are the regulatory agency standards.

The exposure criteria are reported as: time-weighted average (TWA) exposure recommendations averaged over the full work shift; short-term exposure limit (STEL) recommendations for a 10-15 minute exposure period; and ceiling levels (C) not to be exceeded for any amount of time. These exposure criteria and standards are commonly reported as parts contaminant per million parts air

(ppm), or milligrams of contaminant per cubic meter of air (mg/m^3). For the substances monitored during this survey, the environmental criteria are listed below:

Environmental Criteria

Substance	NIOSH	1990 ACGIH	OSHA
Formaldehyde	Lowest Feasible Limit (LFL)*	1 ppm (TWA)**	1 ppm (TWA)
Fibrous Glass	3 Fibers per cc (>10 μm x <3.5 μm)	--	--
Phenol	5.2 ppm (TWA)	5 ppm (TWA)	5 ppm (TWA)
Ammonia	50 ppm (C)	25 ppm (TWA)	35 ppm (STEL)

* Since NIOSH is not aware of any data that describe a safe exposure concentration to a carcinogen, NIOSH recommends that occupational exposure to formaldehyde be controlled to the lowest feasible concentration.

** The ACGIH has proposed lowering the TWA for formaldehyde to 0.3 ppm (C).

B. Toxicology

Formaldehyde

Formaldehyde and other aldehydes may be released from foam plastics, carbonless paper, particle board, plywood, textile fabrics, and phenol-formaldehyde resins systems. Formaldehyde is an intense irritant of the upper respiratory passages. For this reason, systemic poisoning by inhalation is unlikely since workers would be compelled to leave the exposure area before levels sufficient to cause systemic poisoning were reached. Acute exposure to formaldehyde can cause a variety of symptoms. The first symptoms noticed on exposure at concentrations ranging from 0.1 to 5 parts per million (ppm) are burning of the eyes, tearing, and general irritation of the upper respiratory passages. Exposure on the order of 10 to 20 ppm are associated with coughing, tightness of the chest, a feeling of pressure in the head, and palpitation of the heart.[5,6]

Long-term inhalation of formaldehyde gas has been shown to be associated with nasal cancer in experimental animals. Also some studies have demonstrated increased nasal and nasopharyngeal cancer in humans exposed to formaldehyde. Therefore, formaldehyde should be regarded as an potential occupational carcinogen.[5,6]

Skin irritation is a well-known consequence of dermal contact with formaldehyde. The major effects of formaldehyde on the skin are the development of irritant dermatitis and the development of sensitization which leads to contact dermatitis.[6] Symptoms include erythema (redness), edema (swelling), and vesiculation (blistering) or hives.

Formaldehyde is produced endogenously in human beings and is oxidized to formic acid by at least three known enzymatic pathways. It disappears rapidly from the plasma in about 1-1.5 minutes.[7] Such rapid conversion in the plasma makes the use of serum formaldehyde a poor indicator of either current or past exposure. Attempts to find a good biological marker for formaldehyde exposure have proven largely unsuccessful. Urine formic acid has been proposed as a biological exposure but good correlations between air exposures and excretion of formic acid have not been achieved.[8] Formaldehyde is poorly absorbed through the skin so most control measures focus upon airborne monitoring to provide criteria for workplace exposure limits.

Phenol

Exposure to phenol above the evaluation criterion of 5 ppm can cause headaches, dizziness, visual disturbances, weakness, sweating, tremors and convulsions, and unconsciousness. Chronic exposures may cause oliguria and anuria, red and white blood cells in the urine, and albuminuria. Chronic exposures may also cause headaches, coughing, fatigue and weakness, anorexia, nausea, vomiting, insomnia, nervousness, and loss of weight. The odor threshold for phenol, for most individuals, is far below its evaluation criteria. Phenol is well absorbed through the skin, therefore, adequate dermal protection is necessary.[9,10]

Fibrous Glass

The primary health effects associated with fibrous glass involve skin, eye,and upper respiratory tract irritation; a relatively low frequency of fibrotic changes; and a very slight indication of an excess mortality due to nonmalignant respiratory disease. Different dimensions of fibrous glass will produce different biological effects. Smaller diameter (less than 3.5 microns) fibrous glass has not been conclusively related to health effects in humans; but these smaller diameter fibers have the ability to penetrate to the alveoli and this is cause for concern.[11]

There is conflicting information available concerning the carcinogenicity of man-made fibers. Published experimental evidence demonstrates that fibrous glass has the same potential for inducing cancer as asbestos fibers of the same dimensions. There is also published epidemiological data which indicate that there has been a risk of lung cancer in people employed in both the rock

or slag wool and glass wool sectors of the man-made mineral fiber industry.[12]

Ammonia

Ammonia is a severe irritant of the eyes, respiratory tract, and skin. It may cause burning and tearing of the eyes, runny nose, and cough. In a human experimental study which exposed 10 subjects to various vapor concentrations for only five minutes, 134 ppm caused irritation of the eyes, nose, and throat in most subjects and one person complained of chest irritation; at 72 ppm, several reported the same symptoms; at 50 ppm, two reported nasal dryness and at 32 ppm only one reported nasal dryness. In a survey of eight workers in a blueprint shop, ammonia concentrations of 4 to 29 ppm caused "barely noticeable" to "moderate" eye irritation; no respiratory irritation was reported. Tolerance to usually irritating concentrations of ammonia may be acquired by adaptation, a phenomenon frequently observed among workers who were previously effected by exposure; no data are available on concentrations that are irritating to workers who are regularly exposed to ammonia and who presumably have a higher irritation threshold. Liquid anhydrous ammonia in contact with the eyes may cause serious eye injury or blindness; on the skin it causes first- and second-degree burns which are often severe, and if extensive, may be fatal. Vapor concentrations of 10,000 ppm are mildly irritating to the moist skin, while 30,000 ppm or greater causes a stinging sensation and may produce skin burns and blisters.[10]

VI. RESULTS

A. Environmental

Formaldehyde

A total of 10 personal and 5 area samples for formaldehyde were collected in the fibrous glass making and molding areas (Table 1). The full shift personal exposure levels of formaldehyde ranged from 0.07 ppm to 0.41 ppm, with a mean exposure of 0.11 ppm. Only two of the personal samples indicated exposures greater than 0.1 ppm (0.14, and 0.41). The validity of the 0.41 ppm result is questionable when compared to all the other personal and area sample results collected along side this worker at the same time.

It is not possible to differentiate between formaldehyde contributed from the process and from cigarette smoke. All personal formaldehyde samples collected during this survey were exposed to cigarette smoke which contains as much as 40 ppm of formaldehyde by volume.[5] Several individuals that wore samplers smoked and the nonsmoker samplers were exposed to sidestream cigarette smoke in the break area.

The area sampling results ranged from 0.07 ppm to 0.12 ppm, with a mean of 0.09 ppm. These values clearly represent the formaldehyde levels in the work areas where cigarette smoking was not permitted. The levels of formaldehyde measured inside the plant were above the outside background levels which were reported as nondetectable (ND) or trace levels. Trace concentrations are reported when the level falls between the analytical limit of detection and the limit of quantitation. In other words, the material being measured is present but at a level which is too low to be accurately quantified.

The measured levels inside the plant were well below the ACGIH TLV and the OSHA PEL of 1 ppm, but were above the NIOSH recommendation of lowest feasible level. The formaldehyde levels measured during the survey did not differ greatly from the levels of formaldehyde measured in typical private residences. Appendix A summarizes data from many studies of formaldehyde levels in homes in different parts of the United States, Canada, and the United Kingdom. Mobile homes, due to the large amount of pressed wood products in their construction, have the highest formaldehyde concentrations. A mean of 0.4 ppm has been found in most of the studies conducted in mobile homes. Most other types of homes have average formaldehyde levels less than 0.1 ppm. The older (15 years) conventional homes have a mean formaldehyde level of 0.03 ppm and they represent the class of dwellings with the lowest levels of formaldehyde.[7,13]

Phenol

Four personal and five area phenol air samples were collected inside the plant. Only the area samples located on top of the control booth on the deck indicated a trace amount. All other samples were reported as non-detectable. The limit of detection was 0.01 micrograms (μg) per sample and the limit of quantitation was 0.03 μg per sample (0.0003 ppm).

Respirable Fibrous Glass

Eleven fibrous glass air samples (personal and area) were collected inside the plant. The airborne concentrations (Table 2) ranged from less than 0.01 fibers per cubic centimeter of air (fibers/cc) to 0.07 fibers/cc. The concentrations measured were well below the NIOSH REL of 3.0 fibers/cc. Currently, NIOSH feels that its REL of 3 fibers/cc will not provide the degree of protection that OSHA believes is necessary for worker health, and that reduction of the PEL to 0.2 fibers/cc, as was suggested at the Man-made Mineral Fibers Conference, will be necessary to protect workers from the development of lung cancer.[12]

Ammonia

The analytical results for the 15 ammonia air samples, 5 personal passive dosimeters and 10 area short-term impinger samples are presented in Table 3.

The personal TWA exposures ranged from none detected (ND) to 3.6 ppm and the short-term area sample results ranged from 0.57 ppm to 1.92 ppm. The concentrations measured were well below the ACGIH recommended TWA of 25 ppm, the OSHA PEL of 35 ppm (STEL), and the NIOSH REL of 50 ppm (C).

Organic Vapors

Qualitative analysis of the bulk air samples collected on the charcoal tubes indicated the presence of toluene, C_8 to C_{11} hydrocarbons, and C_{16} alkane. However, these substances were present in amounts too small to quantify. The primary source of these substances may be the operation whereby a fire resistant coating is sprayed on the fiberglass.

Overexposure to these substances may cause irritation of the eyes, respiratory tract, and skin. Since they are central nervous system depressants, overexposure may also cause fatigue, weakness, confusion, headache, dizziness and drowsiness. However, the concentrations documented during this evaluation would not be expected to cause adverse health effects in healthy workers.

B. Medical

Fifty-one employees (52.5%) completed the medical questionnaire. Employees were categorized into five groups according to work area. However, responses were similar for the groups and were aggregated.

The average age of the workers surveyed was 35, with 43 males and 8 females responding.

Chronic cough (cough on most days for 3 months or more) was reported by 61%. Phlegm was reported by 53%. Sixty-one percent reported some degree of shortness of breath, with five (10%) claiming the highest level of severity (defined as having to stop for breath when walking at own pace on level ground). Sixty-one percent reported chest tightness, with many of these stating it occurred on all working days. Forty-nine percent reported wheezing, with six percent giving a history of asthma. Twenty percent reported a history of allergies or hay fever.

The prevalence of other symptoms reported by MAP employees to be often present at work (two or more times per week) included 51% for eye irritation, 50% for nose irritation, 43% for cough, 22% for sneezing, 10% for sore throat, and 4% for nose bleeds. Numerous other symptoms were reported to be work related, with the most common being four complaints of numbness and tingling of the extremities and three complaints of headaches.

Fifty-three percent of the workers surveyed report being present or former smokers. Of smokers, the average smoking history is 20 pack years.

Sixty-seven percent of the work force reported skin rash or irritation during the previous 12 months. Most commonly reported sites included exposed skin areas (arms, hands, face).

VII. CONCLUSIONS

The airborne levels of formaldehyde, ammonia, organic vapors, phenol, and respirable fibrous glass measured at the time of the survey were well below the Occupational Safety and Health Administration Permissible Exposure Levels (PEL). Exposures to formaldehyde, although well below the OSHA PEL, were above the NIOSH Recommended Exposure Level. Levels of contaminants measured did not appear to be high enough to account for the high prevalence of symptoms reported. The poor work practices observed appear to be the major contributing factor for the prevalence of eye and skin irritation complaints.

The NIOSH investigator observed that workers were not following proper procedures as prescribed in the Material Safety Data Sheets (MSDS) for the chemical materials used in the process to reduce or prevent skin irritation. In fact, the workers when working with MAP's finished product (Molding Glass Black Cured Insulation, Molded Fiberglass Insulation) were not following the instructions provided in MAP's own MSDS to reduce the possibility of skin irritation. The workers were not wearing appropriate work clothes - long sleeve shirts, goggles, and gloves. Understandably, this may explain why so many of the workers complained of skin rashes and irritation.

The company's written procedure for safety dress states, " all employees are required to wear long sleeve shirts made with natural fiber; also a soft hat and gloves." This was not being enforced and the stated glove requirement is inadequate. The MSDS's for the chemical substances used in the plant specifically recommend that "impervious gloves should be worn". In some instances the MSDS specifies gloves made of butyl rubber, neoprene, etc. The employer had failed to assure the adequacy of protective work clothing, including proper maintenance and sanitation of the equipment.

MAP's MSDS's for its finished products state, "always wash work clothes separately and wipe out the washer/sink in order to prevent loose glass fibers from getting on other articles." Discussion with MAP workers suggested that the employer had failed to make workers aware of this recommendation and the need to wash their work clothes separately.

VIII. Recommendations

A. The workers demonstrated limited knowledge about the possible health effects of exposure to the substances they were working with and the recommended safety precautions. This situation can be remedied by efficient health and safety training programs (hazard communication program).

B. There is potential for some employees to come in contact with liquids containing as much as six percent formaldehyde and practically all employees in the plant come in contact with fibrous glass. OSHA (29 CFR 1910.132)[6] requires that protective equipment, including personal protective equipment, be provided if the potential exists for exposure to a substance capable of causing injury or impairment. 29 CFR 1910.132 further requires that if employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance and sanitation of the equipment.

The following information is excerpted from the OSHA formaldehyde standard (29 CFR 1910.1048):[6]

1. When protective equipment is provided under the provisions of 29 CFR 1910.132 and 29 CFR 1910.133, the employer shall provide these protective devices at no cost to the employee and assure that the employee wears them.
2. All contact of the eyes and skin with liquids containing one percent or more formaldehyde shall be prevented by the use of chemical protective clothing made of material impervious to formaldehyde.
3. The employer shall assure that protective clothing that has become contaminated with formaldehyde is cleaned or laundered before its reuse.
4. The employer shall assure that no employee takes home equipment or clothing that is contaminated with formaldehyde.
5. The employer shall inform any person who launders such clothing of formaldehyde's potentially harmful effects and of procedures to safely handle the clothing.
6. The employer shall provide change rooms for employees who are required to change into protective clothing.

The following is excerpted from the NIOSH Criteria Document for fibrous glass:[11]

1. Protective clothing shall be worn to prevent fibrous glass contact with skin especially hands, arms, neck, and underarms.
2. Locker rooms shall be available for changing into required protective clothing.
3. Protective clothing shall be washed, dried, and inspected before reissue or reuse.
4. The employer shall inform workers exposed to fibrous glass of the importance of laundering work clothes separately from other clothing. In operations where clothes are laundered under contract, contractors shall be informed of the hazards of laundering clothes contaminated with fibrous glass.

C. This survey was conducted during a warm part of the year when the doors to the plant were open to allow for better ventilation (cooling). Also at the time of this survey, a very large drying oven in the fibrous glass making department was not operational. It is recommended that another hazard evaluation be requested when the drying oven becomes operational, preferably during the winter months when the doors are closed which will allow for a "worse case situation".

D. Research has shown that tobacco smoke is not only harmful to the smoker but also to nonsmokers who are exposed to the side stream smoke. We recommend the establishment of a smoke free work environment and encourage offering smoking cessation programs to the employees.

E. MAP International should develop plans for engineering controls to further reduce exposure to formaldehyde.

IX. References

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X. Authorship and Acknowledgements

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XI. Distribution and Availability of Report

Copies of this report are currently available upon request from NIOSH, Division of Surveillance, Hazard Evaluations, and Field Studies, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45526.

After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publication Office at the Cincinnati address. Copies of this report have been sent to:

1. Teamsters Local Union 789
2. MAP International
3. U.S. Department of Labor/OSHA Region III

For the purpose of informing affected employees, copies of this report should be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Mention of brand names does not constitute endorsement by NIOSH, CDC, USPHS, or DHHS.

TABLE 1

FORMALDEHYDE EXPOSURE

MAP INTERNATIONAL
FAIRMONT, WEST VIRGINIA
May 2, 1990
RDHETA 90-145

WORK AREA	JOB	SAMPLING TIME (MIN.)	TWA (PPM)
Fibrous Glass Making	Production	462	0.07
Fibrous Glass Making	Production	473	0.09
Fibrous Glass Making	Utility	477	0.09
Fibrous Glass Making	Operator	481	0.09
Fibrous Glass Making	Relief Person	473	0.07
Fibrous Glass Making	Binder	466	0.09
Fibrous Glass Making	Maintenance	474	0.07
Fibrous Glass Making	Area (Deck Railing)	457	0.12
Fibrous Glass Making	Area (Below Deck)	459	0.09
Fibrous Glass Making	Area (Top of Room - Deck)	453	0.07
Molding (Sterling)	Trimmer	456	0.41
Molding (Bosch)	Molder	460	0.14
Molding (Bosch)	Trimmer	459	0.07
Molding (Sterling)	Area	469	0.09
Molding (Bosch)	Area	465	0.09
Outside of Plant (100 Yards Upwind)		433	Trace*
Outside of Plant (Teamsters Union Hall)		398	ND**

* Trace - Between limit of detection and limit of quantitation.
** ND - Not Detected.

TABLE 2

RESULTS OF AIR SAMPLING FOR
RESPIRABLE FIBROUS GLASS

MAP INTERNATIONAL
FAIRMONT, WEST VIRGINIA
May 2, 1990
RDHETA 90-145

WORK AREA	JOB	SAMPLING TIME (MIN.)	TWA (Fibers
Fibrous Glass Making	Production	462	0.02
Fibrous Glass Making	Shipper	461	0.02
Fibrous Glass Making	Maintenance	--	Voided
Fibrous Glass Making	Area (Deck Railing)	457	0.01
Fibrous Glass Making	Area (Below Deck)	459	<0.01
Fibrous Glass Making	Area (Top of Control Room on Deck)	453	0.01
Molding (Sterling)	Pattern Cutter	456	0.02
Molding (Sterling)	Trimmer	456	0.07
Molding (Bosch)	Trimmer	450	0.02
Molding (Sterling)	Area	469	0.01
Molding (Bosch)	Area	433	0.01
Outside of Plant (100 Yards upwind)		433	<0.01
Outside of Plant (Teamsters Union Hall)		398	<0.01

TABLE 3

RESULTS OF AIR SAMPLES FOR AMMONIA

MAP INTERNATIONAL
FAIRMONT, WEST VIRGINIA
MAY 2, 1990
RDHETA 90-145

WORK AREA	JOB	SAMPLING TIME	CONCENTRATION (PPM)
MAP (Fibrous Glass Making)	Operator	0650-1451	1.60
MAP (Fibrous Glass Making)	Maintenance	0702-1454	1.50
MAP (Fibrous Glass Making)	Maintenance	0701-1455	0.39
MAP (Fibrous Glass Making)	Binder	0704-1450	1.14
MAP (Fibrous Glass Making)	Relief	0654-1447	ND*
MAP (Fibrous Glass Making)	Area (Deck Railing)	0849-0904	1.92
MAP (Fibrous Glass Making)	Area (Deck Railing)	1316-1331	1.53
MAP (Fibrous Glass Making)	Area (Below Deck)	0848-0903	0.96
MAP (Fibrous Glass Making)	Area (Below Deck)	1315-1330	0.57
MAP (Fibrous Glass Making)	Area (Top of Control) (Room on Deck)	0850-0905	1.25
MAP (Fibrous Glass Making)	Area (Top of Control) (Room on Deck)	1317-1332	1.53
Molding (Bosch)	Molder	0657-1437	3.65
Molding (Sterling)	Area	0845-0900	0.57
Molding (Sterling)	Area	1305-1320	0.77
Molding (Bosch)	Area	0805-0905	1.05
Molding (Bosch)	Area	1307-1322	0.86

* ND - Not detected.

APPENDIX A*

Reported Levels of Formaldehyde in the Indoor Air Classes of Private Residences

Type of Residence	No. of Residences	Formaldehyde (ppm) Range	Mean
U.S. homes without urea-formaldehyde foam insulation (UFFI)	41	0.01-0.1	0.03
U.S. homes with UFFI (complaints and non-complaint)	636	0.01-3.4	0.12
U.S. mobile homes	431	0.01-3.5	0.38
Canadian houses without UFFI	383	(3%>0.1 ppm)	0.036
Canadian houses with UFFI	1850	(10%>0.1 ppm)	0.054
U.S. houses without UFFI and without particle board	17	--	0.025
U.S. houses with UFFI but without particle board subfloors	600	--	0.050
U.S. mobile homes	Several hundred		0.12
U.K. buildings without UFFI	50	<0.02->0.3 (3% >0.1 ppm)	0.047
U.K. buildings with UFFI	128	0.01->1 (7% >0.1 ppm)	0.093
U.S. houses without UFFI	42	0.03-0.17	0.06
U.S. houses without UFFI	31	--	0.07
U.S. houses with UFFI	--	--	0.06
Mobile homes (Minnesota complaints)	100	0-3.0	0.04
Mobile homes (Wisconsin complaints)	--	0.02-4.2	0.9
Mobile homes (Wisconsin)	65	<0.10-3.68	0.47
Mobile homes (Washington complaints)	--	0-1.77	0.1-0.44

APPENDIX A (Continued)

Reported Levels of Formaldehyde in the Indoor Air Classes of Private Residences

Type of Residence	No. of Residences	Formaldehyde (ppm) Range	Mean
U.S. Mobile homes			
Never occupied	260	--	0.86
Older occupied			0.25
East Tennessee homes	40	<0.02-0.4	0.06
Age 0-5 years	18	--	0.08
Age 5-15 years	11	--	0.04
Age >15 years	11	--	0.03
Conventional California, Colorado, and South Dakota homes	64	0.02-0.11	0.05
Specialized U.S. housing	52	0.03-0.3	0.1

* Gammage R.B., Hawthorne A.R. "Current Status of Measurement Techniques and Concer of Formaldehyde in Residences." Turoski V. Formaldehyde: Analytical Chemistry and Toxicology. Page 125. "Developed from a symposium sponsored by the Division of Environmental Chemistry at the 187th Meeting of the American Chemical Society, St. L Missouri, April 8-13, 1984."