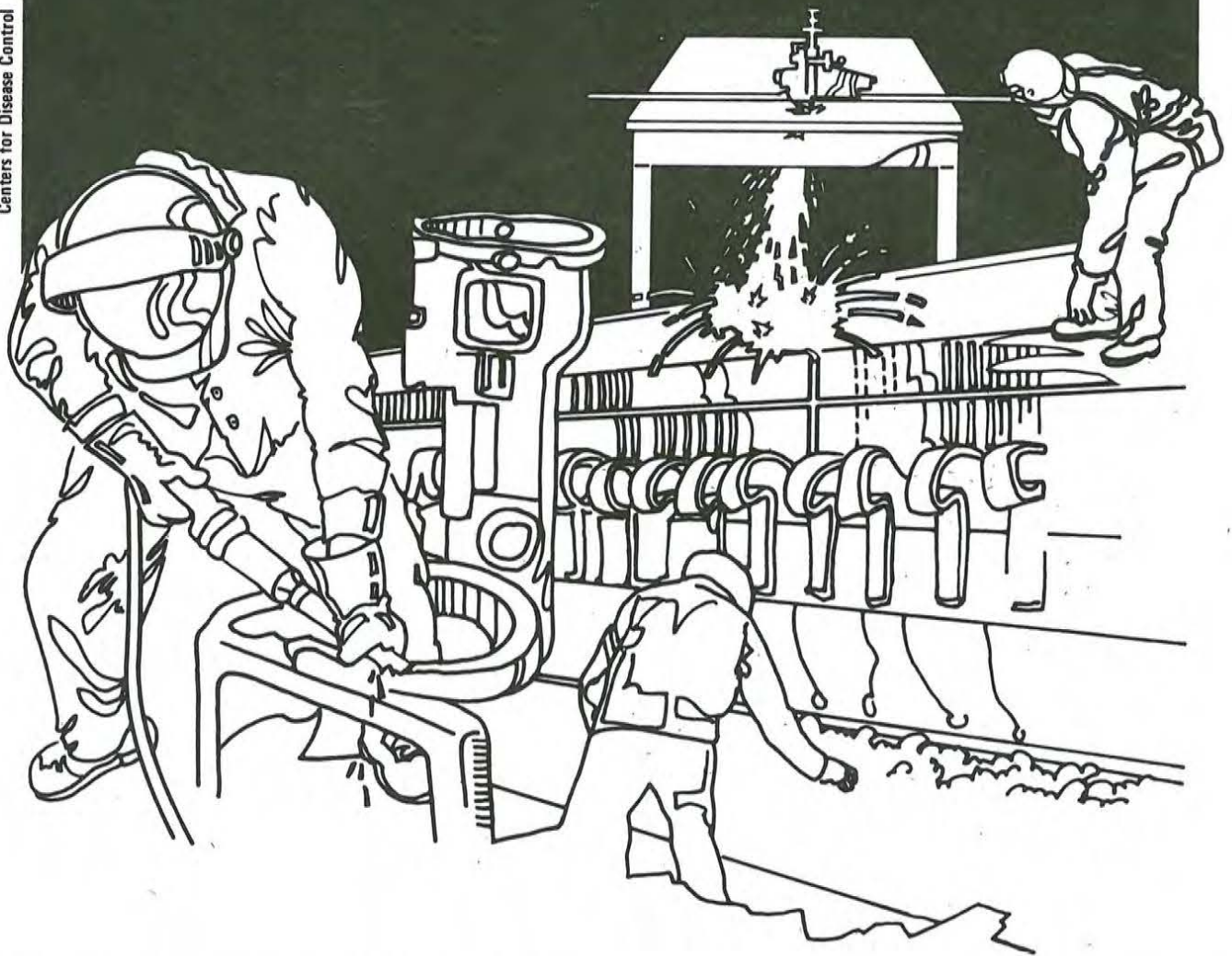


NIOSH



Health Hazard Evaluation Report

HHE 80-201-816
PETERSON/PURITAN COMPANY
MOMENCE, ILLINOIS

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. 699(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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HE 80-201-816
FEBRUARY 1981
Peterson/Puritan Company
Mokenca, Illinois

NIOSH INVESTIGATORS:
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I. Summary

On July 12, 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Chemical Workers Union to evaluate employee exposures to solvents in a commercial spot remover being packaged at Peterson/Puritan, Inc., Mokenca, Illinois. The requester was particularly concerned with the possibility that reproductive hazards might be associated with exposures to methyl chloroform (1,1,1-trichloroethane) and perchloroethylene (tetrachloroethylene). The request stated that some of the female employees were experiencing problems with conception which they believed to be work related.

The plant is engaged in the packaging of commercial aerosols and lotions. The packaging of the spot remover occurs on average twice a month. The product is compounded in a isolated room and piped out to the packaging line. Six employees are periodically involved in the compounding process, and 41 on the packaging line.

NIOSH investigators conducted an initial survey in August 1980. An environmental survey was performed in September 1980 and short term continuous samples were collected for determination of ceiling and full shift exposures to methyl chloroform and perchloroethylene. During these surveys, confidential interviews were conducted with employees.

Analysis of environmental samples indicates no exposures above NIOSH recommended environmental criteria for methyl chloroform or perchloroethylene. Of 33 employees surveyed (87% of the currently exposed workforce) 85% reported symptoms associated with acute exposure to chlorinated hydrocarbon solvents. These interviews revealed no evidence for associating reproductive problems with this work process.

On the basis of the data obtained in this investigation, NIOSH determined that a health hazard from exposure to methyl chloroform and perchloroethylene did not exist at the time of this survey. However, in light of the significant number of employees experiencing symptomatology associated with acute exposure to these solvents, coupled with current evidence that perchloroethylene has been found to be carcinogenic in mice, it would be prudent to implement the recommendations incorporated in section VIII of this report which are designed to further reduce acute and chronic exposures to these substances.

KEY WORDS: SIC 7399 (Business services), perchloroethylene, tetrachloroethylene methyl chloroform, 1,1,1-trichloroethane, spot remover, packaging, chlorinated hydrocarbon solvents

II. INTRODUCTION

On July 12, 1980 an authorized representative of the International Chemical Workers Union, AFL-CIO, submitted a health hazard evaluation request concerning possible reproductive hazards faced by packaging line workers canning a commercial spot remover at the Peterson/Puritan plant in Momence, Illinois. The request alleged that some of the female employees were experiencing problems with conception which they believed to be work related; specifically, to the solvents used in the production of the spot remover.

NIOSH investigators responded to the request by conducting an initial survey on August 21, 1980. An opening conference was held with representatives of management and the local union, followed by a walk-through survey of the areas involved in compounding and packaging of the product. An environmental survey was conducted on September 15, 1980 and environmental samples were collected to evaluate employee exposure to perchloroethylene and methyl chloroform. During the course of these surveys, confidential interviews were conducted with employees in the areas of possible exposure.

III. BACKGROUND

A. Plant Production and Workforce

The plant is engaged in the packaging of commercial aerosols and lotions. The facility packages a variety of different products. Production schedules, as well as the products themselves, may vary greatly with the current consumer demand. The packaging of the spot remover has occurred only within the last year and a half of the approximately four years that the plant has been in operation. This process takes place on an average of 2 days per month. One employee is required for the compounding operation which takes place in an isolated room within the facility. Packaging of the product occurs on line #1 in the production building. Approximately 20 employees work on this line during each of the two shifts.

B. Process Description and Employee Duties

In the compounding room located adjacent to the production area of the plant, the perchloroethylene and the methyl chloroform are piped into the mixing tank. During the addition of these chemicals all openings to the mixer remain closed. The remaining ingredients are hand charged into the mixer through the metal tank door on the top of the mixer. This door is then closed and the ingredients are automatically mixed. After mixing, the tank door is opened to remove samples for quality control testing. The finished product is then piped out to the production line for packaging.

The packaging process begins as empty cans are placed on the production line by a semi-automatic depalitizer operated by an employee. The cans are placed onto the conveyor and pass through the "coder" to be stamped with the appropriate product information, and are then passed under a gravity "filler" which dispenses the appropriate quantity of the spot remover; with a single employee overseeing both operations. The cans then pass under the "valve placer", operated by a single employee, which automatically places the valve into the cans. At this point the cans leave the regular production building and enter the gas house. This area is separated from the rest of the production line by two concrete walls with hermetically sealed doors in each.

Once inside this building the valves are crimped to the cans at the "sealer", then are injected with propane propellant at the "gasser". The maintenance helper is responsible for the proper operation of the machines within this building. After the cans leave the gas house, buttons are placed on the top of the valves at the "button tipper", which is operated by a single employee. The cans then pass submerged through an enclosed tank of heated water so that any leaks can be visually detected by the attendant employee. The cans are next weighed by an employee to insure the proper level of the contents. Eight employees are utilized to hand cap and package the cans in cardboard boxes. The boxes are then stacked and eventually removed from the area by fork lift truck for storage and subsequent shipment.

C. Engineering, Administrative, and Personal Protective Controls

All employees in the production building are required to wear safety glasses. Ear plugs and rubber gloves are made available on request. Additionally, the employee working at the hot tank is required to wear a face shield and insulated gloves. The compounder is required to wear a respirator when charging materials into the mixer.

The production building is equipped with air conditioning, utilizing ceiling fans located approximately 20 feet above the line, for additional air movement at the packaging stations. Local exhaust ventilation is present at the filler, the button tipper, and the hot tank. Additionally, the gas house and compounding room are equipped with separate ventilation systems to alleviate the build-up of explosive concentrations of any of the gasses.

Administrative control of employee exposure is achieved through rotation of the employees through the various positions on the packaging line. Each employee works at 4 different locations during the course of an eight hour shift.

IV. MATERIALS AND METHODS

Since administrative control of personal exposures was achieved through the rotation of the employees among the different job locations, continuous short term samples were collected to enable characterization of the environmental exposures at each work station. Also, since the exposure at each location remains relatively constant during the normal operating conditions, this sampling method could be used to provide information on ceiling as well as full shift time weighted average (TWA) exposures.

Personal samples were collected at the employees breathing zone to assess exposures to perchloroethylene and methyl chloroform. The sampling train consisted of a battery powered pump operating at 50 cubic centimeters of air per minute (cc/minute) attached via tygon tubing to a charcoal tube. The charcoal tubes were replaced periodically to provide information on the exposure levels at the various work stations. The samples were later analyzed according to NIOSH method P&CAM 127 modified¹.

A Draeger hand pump and direct reading indicator tubes were used to detect instantaneous levels of perchlorethylene and methyl chloroform, both on a routine basis and in the event of a "spill".

A non-directed occupational health questionnaire was confidentially administered to the exposed employees. Additionally, a supplemental

questionnaire was administered with questions relating specifically to the known effects of the toxins as well as the reproductive histories of the employees.

V. EVALUATION CRITERIA

A number of sources recommend airborne levels of substances under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Such airborne levels are referred to as standards or threshold limit values. It is believed that concentrations below these limits represent conditions under which workers may be repeatedly exposed 8-10 hours per day, 40 hours per week, without suffering serious adverse health effects. Due to variations in individual susceptibility, some workers may experience effects at levels at or below the threshold limit; a small group may be more seriously affected by aggravation of a pre-existing condition or by a hypersensitivity reaction².

A. Perchloroethylene

The NIOSH recommended standard for occupational exposure to perchloroethylene is 50 ppm on a TWA basis, or a ceiling concentration of 100 ppm as determined by a 15 minute sampling period³. This level is designed to protect the workers health and safety by preventing the adverse effects of this substance. Perchloroethylene has been found to be primarily toxic to the liver, kidneys, skin, mucous membranes, and nervous system of human beings. The principal central nervous system symptoms include vertigo, impaired memory, confusion, fatigue, drowsiness, irritability, loss of appetite, nausea, vomiting, and at higher doses, coma and respiratory paralysis. The peripheral nervous system is also affected and may produce tremors and numbness. The skin and mucous membranes are irritated by exposure to perchloroethylene and may be burned if the dose is of a sufficient level. Toxic hepatitis is the primary response of the human liver, but laboratory mice have been reported to develop hepatocellular carcinoma following exposure, and therefore NIOSH has recommended handling this chemical in the workplace as a potential human carcinogen.

The current federal standard for perchloroethylene is 100 ppm for an eight hour TWA. The acceptable ceiling concentration shall not exceed 200 ppm for a period greater than 5 minutes in any three hours, with concentrations above the ceiling limit not to exceed 300 ppm⁴.

B. Methyl Chloroform

The NIOSH recommended level for occupational exposure to methyl chloroform is a ceiling concentration of 350 ppm as determined by a 15 minute sampling period⁵. This level is designed to protect the workers health and safety by preventing the adverse effects of this substance. The primary health effects from exposure to methyl chloroform include central nervous system depression, headache, dizziness, incoordination, lightheadedness, drowsiness, generalized weakness, toxic hepatitis, nausea, vomiting, diarrhea, hypotension, bradycardia, cardiac arrhythmias, coagulopathies, skin dryness and irritation, and mucous membrane irritation. Due to the similarity between this chemical and a group of known animal carcinogens, NIOSH recommends care in the industrial use of this agent, though no evidence exists at the current time either in animals or humans to implicate this agent as a carcinogen⁶.

The current federal standard for exposure to methyl chloroform is 350 ppm on an eight hour TWA basis⁴.

VI. RESULTS

A. Environmental

Analysis of the personal samples collected showed levels well below the recommended environmental limits. A complete listing of the environmental results are given in Table 1. Cumulative time weighted average values for assessing personal exposures to perchloroethylene ranged from 8.5 to 16 ppm with a mean of 11 ppm. The NIOSH recommended standard is 50 ppm on a 10-hour TWA basis. The short-term samples collected to determine ceiling exposures to perchloroethylene ranged from 4.7 to 25 ppm, with a mean of 14 ppm. The NIOSH recommended standard is 100 ppm for ceiling exposures as determined by a 15 minute sampling period.

Short term sample values for exposure to methyl chloroform ranged from 6.9 to 70 ppm, with a mean of 27 ppm. The NIOSH recommended standard is 350 ppm for ceiling exposures as determined by a fifteen minute sampling period.

Periodic samples taken with the indicator tubes were below the level of sensitivity of 10 ppm for the perchloroethylene, and 50 ppm for the methyl chloroform tubes.

B. Medical

Of a total of 47 workers that may be exposed to the components of the spot remover, 23 line workers, 6 production line support workers (mechanics, etc.), and 6 compounders were interviewed by the NIOSH investigators. Another 5 workers refused to be interviewed and an additional seven employees currently working on line #1 were new and unexposed to the spot remover. Further, 1 line worker and 1 compounder that were interviewed had no exposure to the spot remover production process. Therefore, 33 of the 38 (87%) exposed workers were interviewed. The mean age of the 33 interviewed exposed workers was 30 years with a standard deviation of 9.7 years, the oldest being 56 years old and the youngest 19 years old. There were 11 males and 22 females, 22 worked the day shift and 11 the afternoon. All but 6 had been at these jobs for the total time (one year) that the spot remover had been packaged in the plant.

SYMPTOMS REPORTED BY WORKERS ON PACKAGING LINE
(n=33)

<u>SYMPTOM</u>	<u>NUMBER OF WORKERS REPORTING</u>	<u>%</u>
Lightheadedness	16	48%
Headaches	17	52%
Mucous Membrane Irritation	11	33%
Numbness and/or Tingling in hands or feet.	7	21%
Blurring of Vision	2	6%
No Symptoms	5	15%

With respect to reproductive problems:

Five women had problem pregnancies prior to employment at this plant.

Two of these women had been trying to conceive over the past year.

The first had a premature birth 15 years ago and has been trying to conceive again for the past 2 years.

The second had 2 spontaneous abortions, 9 and 6 years ago, and has been trying to conceive for the past year.

One woman had been trying to conceive for three years and became pregnant 3 months ago.

One man indicates an inability to father children for the past 6 years.

A medical work up was not obtained for this individual,

VII. DISCUSSION

The question posed concerning reproductive hazards at this work place are difficult to answer due to the small population size, intermittent nature of the exposure, and short duration of the functioning of this industrial process. There is no information either in this population or in the literature as a whole that birth defects are associated with exposures to these chemicals. The available literature, which is not extensive, also reveals no association between inability to conceive and exposure to these toxins.^{7,8} In this group of workers, all problems with conception seem to pre-date the introduction of the spot remover packaging process at the plant. Whether this exposure has added to the problem in the 2 women and 1 man trying to conceive is impossible to say, but there is no evidence available to support this contention.

Despite the low level of exposure indicated by the sampling results, approximately 85% of the employees exposed to the spot remover packaging process have experienced one or another of the typical acute symptoms related to perchloroethylene and/or methyl chloroform. Based on information obtained during the interviews, many of these complaints may be attributable to incidents in which the normal packaging process has been interrupted. Although it was not observed during the time of the survey, many of the employees indicated that periodically there had been "spills" or instances where, due to mechanical or operator failures, the spot remover had spilled onto the production line. The "filler" operation was one area that was noted to be particularly susceptible to such occurrences. Due to poor design, the local ventilation present at this operation is insufficient to control the exposure during such incidents. Another area that appeared to pose a possibility for an acute exposure hazard was the "button tipper". When this machine places the caps onto the valve stem, a small amount of the contents may be sprayed into the air. In one instance noted during the survey, the machine became jammed, causing one can to spray continuously. Although the ventilation appeared to operate effectively during normal operating conditions, it is probable that it may prove inadequate under such circumstances. This is reinforced by the environmental results in Table 1. The exposure for employee #5, who was operating the machine during the above-mentioned incident, approaches twice the exposure of employee #2 who operated the machine under normal conditions. It should also be noted that employee #5 was somewhat unfamiliar with the operation of the machine which may have contributed to the mechanical problem. Since this operation appears to be a significant source contributing to the generation of the solvent vapors into the general production line environment, any improvement in this ventilation should serve to reduce the overall exposure level.

VIII. RECOMMENDATIONS

1. Local ventilation at the filler and the button tipper should be modified to provide for a more effective control of the contaminants. The design defects in the present systems were discussed with company representatives during the survey visits.
2. Employees should receive proper training and supervision in the operation of the machinery. Particular attention should be given to preventing spills or other incidents which may cause significant quantities of the solvents to be released into the work area.
3. Any skin contact with the solvent mixture should be avoided. The proper gloves and clothing should be worn to the extent needed to prevent this.
4. Until they can be properly disposed of, leaking cans should be stored in a well ventilated area to prevent the solvent mixture from entering into the workroom environment.

IX REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH publications office at the Cincinnati address. Copies of this report have been sent to the following:

- A. International Chemical Workers Union, Akron, Ohio
- B. International Chemical Workers Union, Local 1004
- C. Peterson/Puritan, Inc.
- D. U. S. Department of Labor, OSHA - Region V
- E. NIOSH Regional Offices/Divisions

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

Table 1
Perchloroethylene and Methyl Chloroform Concentrations
 (Samples collected September 15, 1980)

Employee Number*	Job Description	Exposure Time (minutes)	Perchloroethylene (ppm)	Methyl Chloroform (ppm)	Cumulative TWA** Perchloroethylene (ppm)	Cumulative TWA Methyl Chloroform (ppm)
1	Valve Placer	89	13	38	8.5	18
	Depalitizer	112	4.7	6.9		
	Capper & Box Maker	192	8.6	15		
		393				
2	Button Tipper	85	16	27	11	19
	Capper	116	15	26		
	Packer & Depalitizer	190	6.7	12		
		391				
3	Filler	98	15	26	9.5	17
	Capper	109	13	24		
	Depalitizer & Capper	201	5.0	8.5		
		408				
4	Gas House	203	16	29	16	26
	Gas House	191	17	23		
		394				
5	Button Tipper	82	29	45	***	***
6	Compounder	163	25	70	8.5	4
		480				

Abbreviations: ppm = parts of contaminant per million parts of air
 TWA = time weighted average

* Employee numbers are randomly assigned

** Cumulative TWA values are calculated by combination of short term consecutive sample values.

*** Lack of exposure data does not permit estimation of cumulative TWA.

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