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OWENS-ILLINOIS GLASS CONTAINER DIVISION
HAPEVILLE, GEORGIA

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I. SUMMARY

On January 5, 1986, an official of the Glass, Pottery, Plastics and Allied Workers Union, Local 101, requested a NIOSH health hazard evaluation of worker exposures to methylene chloride or other contaminants at the Wrap Sleeve Labelling (WSL) machines in the Selecting Department of the Owens-Illinois glass bottle factory in Hapeville, Georgia. The union expressed concern about possible concurrent exposures to carbon monoxide and methylene chloride. The union reported symptoms of headaches, dizziness, chest tightness, and hoarseness among workers after a methylene chloride spill had occurred. The union expressed concern about the introduction of methylene chloride into the workplace within the past year and about recent toxicological test results indicating the carcinogenic potential of the substance.

On March 31 - April 2, 1986, a NIOSH epidemiologist and two industrial hygienists conducted an initial survey at the Hapeville plant. During the survey, self-administered questionnaires were completed by 21 employees with suspected exposures to methylene chloride, and by an unexposed comparison group of 23 workers from the Shipping Department warehouse.

Industrial hygiene air samples were collected during the 3-11 PM shift on April 1 and during the 7AM - 3PM shift on April 2. Personal air samplers were worn throughout the shift by WSL operators, relief operators, and the A1/A2 line zone mechanics to measure their personal exposures to methylene chloride vapor and carbon monoxide gas. Limited air sampling was also conducted in the Shipping Department's warehouse to compare to the levels of methylene chloride and carbon monoxide found in the Selecting Department.

No personal exposures in the WSL process exceeded 9 ppm for either methylene chloride (MC) or carbon monoxide (CO). The OSHA permissible exposure limits are 500 ppm (as an 8-hr. average) for MC and 50 ppm for CO. NIOSH's recommended exposure limits are the lowest feasible level for MC, and 35 ppm for CO. The questionnaire revealed no significant differences in reported symptoms between the MC-exposed group and the non-MC-exposed group from the Shipping Deptartment, and no apparent pattern of symptoms in either group.

Although exposure levels of methylene chloride and carbon monoxide were low in comparison with the existing OSHA standards, NIOSH recommends that exposure to methylene chloride be reduced to the lowest feasible level due to its carcinogenic potential. Recommendations to minimize CO and MC exposures are contained in Section VIII of this report.

Keywords: SIC 3221 (Glass containers), methylene chloride, bottles, label application

II. INTRODUCTION

On January 5, 1986, an official of the Glass, Pottery, Plastics, and Allied Workers Union, Local 101, requested a health hazard evaluation of worker exposure to methylene chloride in the Selecting Department of the Owens-Illinois Glass Company, Hapeville, Georgia. The union expressed concern about possible concurrent exposure to carbon monoxide and methylene chloride. The union also questioned whether the heat shrinking process might produce toxic thermal decomposition products from methylene chloride. The formal written request reported symptoms of headache, dizziness, chest tightness, and hoarseness among workers after a spill had occured. The union expressed concern about the introduction of methylene chloride into the workplace within the past year and about recently released toxicological test results indicating potential carcinogenic effects.

On March 31 - April 2, 1986, NIOSH investigators conducted an industrial hygiene and epidemiologic survey at the facility. Air sampling was performed for methylene chloride and carbon monoxide. A questionnaire was administered to workers exposed to methylene chloride and to a similiar group of warehouse workers not exposed to methylene chloride. An initial letter report summarizing the survey was provided to the company and union on May 7, 1986. In that letter, carbon monoxide sampling results were provided, and several recommendations were offered to improve working conditions. A second letter report was provided on June 3, 1986, giving the results of the air sampling for methylene chloride vapor.

III. Background

Process Description

The factory manufactures a large variety of glass bottles and containers. The area of concern in this investigation was limited to the "wrap sleeve labeling" (WSL) process in the Selecting Department. In the WSL process, previously-manufactured labels are applied to glass bottles using methylene chloride (MC). The process operates three shifts per day. Four shifts of workers are employed and work on a rotating shift basis.

The labels are made of a thin sheet of polystyrene plastic which comes as a continuous sheet wound into a roll about three feet in diameter. The label roll is fed into the WSL machine where it is cut into "sleeves" of an appropriate size to wrap around the bottle as labels. A small amount of methylene chloride (MC) is applied to the leading edge and trailing edge of the sleeve. The MC moistens the foam sleeve causing it become tacky for application to the bottle. The labels are then shrunk tightly around the bottle by a proprietary heat shrinking process.
The MC is applied to the labels using a proprietary application process. The solvent application assembly is enclosed with a local exhaust ventilation system. MC is delivered to each machine from a 55 gallon drum, using a gravity flow system. One WSL machine uses a 55 gallon drum every 9 shifts (3 days). Several of the bottle lines are equipped with the WSL process. Each line requires one WSL operator per shift. A relief operator is also employed on each shift to rotate between the lines while the other WSL operators take breaks or meals.

The drum set-up and changeovers are performed by mechanics from the Gauge Shop. The mechanics also perform repair and maintenance of the WSL machines and the MC delivery system. Excess MC applied by the application process is recirculated. On occasion, bits of plastic labels clog the drain or filter, causing overflows of MC onto the floor of the workroom. The company has reported to NIOSH that, since the time of the survey, changes have been made to the filter system which have been effective in preventing overflows.

Propane-powered lift trucks operate in the area to pick up and remove cartons of finished bottles. The fork lift trucks exhaust carbon monoxide into the same work area where the MC is used.

IV. EVALUATION DESIGN AND METHODS

Environmental

Methylene chloride (MC) vapor was sampled by drawing air at a rate of 0.035 liters per minute (1pm) through two charcoal tubes connected in series. Sample tubes were changed at approximately 2-hour intervals. The air was drawn through the tubes using belt-mounted, battery-powered, miniature air sampling pumps. MC vapor was collected from the air by adsorption on granular activated charcoal. After sampling, the tubes were capped and submitted to the laboratory for analysis. Samples were analyzed by gas chromatography according to NIOSH Analytical Method 1005 with modifications.[1]

A direct-reading carbon monoxide (CO) monitor, the Ecolyzer Model 6000, was used to get a general idea of carbon monoxide levels in the areas being investigated. Personal samples to measure employee exposure to carbon monoxide were obtained using direct reading, long-term Drager gas detector tubes. Air was pulled through the sampling devices by battery-operated pumps worn on the workers' belts.

Air samples for MC and CO were collected during the 3-11 pm shift on April 1 and during the 7AM - 3PM shift on April 2. Personal air samplers were worn throughout the shift by WSL operators, relief operators, and the A1/A2 line zone mechanics to measure their personal exposures to methylene chloride vapor and carbon monoxide gas. Limited air sampling was also conducted in the Shipping Deparment's warehouse to compare to the MC and CO levels found in the Selecting Department. On April 1, an area sample was collected in the central part of the warehouse. On April 2, personal sampling was conducted for the pallet plastic stretch-wrap operator who worked in an area with considerable lift truck traffic.

Medical Questionnaire

Forty-four questionnaires were administered to employees of Owens-Illinois. The questionnaire was designed to quantitate possible symptoms of acute intoxication (CNS depressant effects) with methylene chloride and to identify those employees which may be suffering from longer term or chronic effects from the solvent. Twenty-one people were identified as working in the WSL operation of the Selecting Dept., the area specified in the health hazard evaluation request. These workers constituted the exposed group. An additional twenty-three people from the shipping department completed the questionnaire, and these personnel comprised the unexposed group.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

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 are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, thus potentially increasing 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 for the workplace are: 1) NIOSH criteria documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (AGGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational safety and health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that employers are legally required to meet those levels specified by an OSHA standard.

METHYLENE CHLORIDE

Methylene chloride is a chlorinated organic solvent. It may have anesthetic properties if inhaled in high concentrations. Symptoms of overexposure may include mental confusion, light-headedness, nausea, vomiting, and headache. Continued exposure to very high concentrations may cause increased light-headedness, staggering, unconsciouness, and death. High vapor concentrations may also cause irritation of the eyes and respiratory tract. Exposure to methylene chloride may aggravate the symptoms of angina. If the liquid is held in contact with the skin, it may cause irritation or skin burns. Splashes of the liquid into the eyes may cause irritation. Rats and mice have developed tumors and cancers after exposure to methylene chloride under specific experimental conditions.[2]

The current OSHA standard for worker exposure to methylene chloride is 500 parts of methylene chloride vapor per million parts of air (ppm) averaged over an eight-hour work shift, with an acceptable ceiling level of 1000 ppm and a maximum peak concentration of 2000 ppm for 5 minutes in any two-hour period. In 1976, NIOSH recommended that the permissible exposure limit be reduced to 75 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 500 ppm averaged over a 15-minute period. NIOSH further recommended that permissible levels of methylene chloride be reduced when carbon monoxide is also present at concentrations greater than 9 ppm, measured as an average exposure for the shift.[3] Since 1976, the carcinogenicity of methylene chloride has been documented in several studies of chronic effects in animals. Therefore, in 1986, NIOSH recommended that methylene chloride be regarded as a "potential occupational carcinogen," and that exposure be controlled to the lowest feasible level.[4]

CARBON MONOXIDE [5]

Carbon monoxide (CO) is a colorless, odorless, tasteless gas produced by incomplete burning of carbon-containing materials. The two main sources of human exposure to CO are engine exhaust and tobacco smoking. On inhalation, carbon monoxide acts as an asphyxiant, causing a decrease in the amount of oxygen delivered to the body tissues. CO combines with hemoglobin (the oxygen carrier in the blood) to form carboxyhemoglobin, which reduces the oxygen carrying capacity of the blood. The initial symptoms of CO poisoning may include headache, dizziness, drowsiness, and nausea. These initial symptoms may advance to vomiting, loss of consciousness, and collapse if prolonged or high exposures are encountered. Coma and death may follow if high exposures continue without intervention. Long term low level exposure to CO can increase the risk of heart attack for some people.

The criteria used to evaluate occupational exposure to CO are:

OSHA	Permissible exposure limit	50 ppm TWA
NIOSH	Recommended exposure limits	35 ppm TWA 200 ppm Ceiling
ACGIH	Threshold limit values	50 ppm TWA 400 ppm STEL

TWA = 8-hour time-weighted average
Ceiling = level not to be exceeded at any time
STEL = short term exposure limit, a 15-minute time-weighted Average which should not be exceeded at any time during a work day

The blood of cigarette smokers usually contains 2 to 10 per cent, sometimes as high as 18 per cent, carboxyhemoglobin. Non-exposed persons have an average level of 1 per cent or less; heme metabolism is an endogenous source of CO. NIOSH recommends an allowable level for CO in air of 35 ppm based on an 8-hour time-weighted average exposure so that COHb per cent does not exceed five. The current allowable OSHA limit of 50 ppm is designed to maintain COHb less than 10%.

B. Medical Criteria (from Lauwerys, 1983) [6]

Methylene chloride or dichloromethane, is a volatile solvent that is easily absorbed by the lung (retention: 55-70%) [7,8] and probably also by direct contact with the liquid form.[9] It is partly metabolized by the body to carbon monoxide and carbon dioxide.[7,8,10,11,12] Measurement of methylene chloride in blood or expired air, carbon monoxide in expired air, and carboxyhemoglobin in blood can be used to monitor the magnitude of exposure.

A detailed study of the relationship between these parameters has been undertaken by DiVincenzo and Kaplan.[8,13] Non-smoking, sedentary volunteers were exposed for 7.5 hr to methylene chloride vapor concentrations ranging from 50 to 200 ppm. At the end of the exposure period, the concentration of the solvent in alveolar air (ppm), in venous blood (mg/100 ml) and the percent carboxyhemoglobin saturation, respectively, were monitored. The averaged results are as follows:[8]

	in alveolar air (ppm)	in venous blood (mg/100 ml)	COHB %
for 50 ppm:	15	0.03	1.9
for 100 ppm:	35	0.08	3.25
for 150 ppm:	55	0.12	5.3
for 200 ppm:	80	0.18	6.8

The carboxyhemoglobin level exceeds 8% after an exposure to 250 ppm methylene chloride for 7.5 hr.[14] For a 200 ppm exposure, the mean post-exposure tidal air concentrations of methylene chloride decreases to 1 ppm at 16 hr.[8] According to Stewart et al [9], 16-20 hours after exposure to 50 or 100 ppm methylene chloride for 7.5 hr, the level in expired air is less than 0.1 ppm.

DiVincenzo and Kaplan[8] have estimated that an 8-hour exposure to about 150 ppm of methylene chloride vapor is equivalent to an 8-hour exposure of about 35 ppm of carbon monoxide, inasmuch as either exposure under sedentary conditions will increase blood carboxyhemoglobin levels to about 5% of saturation. An exposure to 1000 ppm methylene chloride increases the carboxyhemoglobin level to 10-15%.[15,16]

As expected, physical exercise performed during exposure to methylene chloride vapor will produce higher blood carboxyhemoglobin saturations than those found in sedentary workers.[7,13] Hence under moderate workload, an exposure to 100 ppm methylene chloride for 7.5 hr may cause a carboxyhemoglobin saturation of about 5% at the end of the exposure period.[13] The combined effect of smoking and exposure to methylene chloride produces an additive increase in blood carboxyhemoglobin values.[13]

VI. RESULTS AND DISCUSSION

A. Environmental Results

No carbon monoxide exposures of 9 ppm or above were measured in the Selecting Department during the two shifts sampled. Results of the long-term detector tube samples worn by the workers are shown in Table 1.

A large amount of lift truck traffic was observed in the Shipping Department warehouse. The trucks are powered by propane. Readings obtained on a direct-reading carbon monoxide monitor, the Ecolyzer Model 6000, ranged from 20 to 80 ppm at various areas within the warehouse. The sample collected in a central, but not very busy, area of the warehouse during the 3-11 PM shift on April 1 measured an average concentration of 17 ppm. Since the NIOSH investigators had not anticipated sampling for carbon monoxide in the warehouse, there was not sufficient equipment on hand to evaluate personal exposures of lift truck drivers.

The methylene chloride levels to which workers were exposed at the time of our survey are shown in Table 2. The individual samples ranged from none detected to a high of 8.9 ppm. The highest average exposures on both shifts were the WSL operators on the E-1 line, 3.6 ppm and 6.9 ppm. Exposures were considerably less on the other lines.

During our survey, the WSL machine on the E-1 line malfunctioned much of the time, requiring considerable maintenance, and providing an explanation for the higher personal exposures measured on that line, versus the A-1 and A-2 lines. However, there were no filter or drain clogs on the WSL machines during our survey. Hence, there were no spills or overflows, so it was not possible to measure the airborne levels during such an episode. The spill or overflow episodes were a major concern of the union.

The union was also concerned that MC might be thermally converted in the heat shrinking process to toxic byproducts, such as phosgene and hydrochloric acid (HCl). This seems improbable since (1) the company reports that the MC is largely dried and the vapor dissipated before reaching the heat shrinking step, (2) the temperature (500 degrees F) and speed with which the bottles pass through the heat shrinking stage provide limited opportunity for thermal breakdown, and (3) the heat shrinking process is local exhaust ventilated. However, direct-reading Drager gas detector tubes were used to sample air at the periphery of the heat shrinking equipment for phosgene and HCl. None was detected.

B. Medical Questionnaire

The results of the questionnaires completed by the two groups are compared in Table 3. Analysis is complicated by the fact that relatively high CO levels were measured in the shipping department, so that these workers might better be described as the "not exposed to methylene chloride group." However, these considerations aside, no particular differences were observed between the two groups. Also, in the opinion of the NIOSH investigator, there was not any obvious pattern of symptoms within either of the groups.

Exposures to methylene chloride vapor, as measured during the period of the health hazard evaluation field survey, are very low. At measured concentrations, it is unreasonable to suppose that acute anesthetic effects might occur. Although the concern for potential low-dose or neurotoxic effects remains, the solvent is neither present in substantial concentrations, nor has it been used in this workplace for a period of time thought necessary to evidence such symptoms.

As described previously, research has shown that concentrations above 100 ppm must be experienced for at least seven hours to materially contribute to COHb in the blood. Even then, at levels between 2-10%, %COHb saturation does not necessarily correlate well with either symptoms or possible health hazard. Since individual tolerance to CO varies widely, and because no chronic health effects from sporadically elevated CO levels have ever been determined, the concern for monitoring COHb should only be present when workers are concurrently exposed to significant levels of both CO and methylene chloride.

Attempting to predict the degree of hazard in the workplace, or presence or absence of a health effect in an employee, from a single or "spot" check of %COHb saturation is both fruitless and wasteful. At the very minimum, this type of biomonitoring should be coupled to the measurement of the same employee's personal breathing zone concentration of potential sources of COHb during a full shift, a detailed smoking history, and preferably the workers pre-shift COHb level.

VII. CONCLUSIONS

Methylene choride exposures in the WSL process ranged from none detected to 9 ppm under the conditions of operation that existed at the time of the NIOSH survey. Airborne exposure appeared to be well controlled by local exhaust ventilation, keeping the preponderence of exposures in the 0.2 - 4 ppm range. However, exposure during overflow or spills could pose a potential short-term exposure problem.

No significant differences in reported symptoms were observed from comparison of questionnaires from the MC-exposed group and the non-MC-exposed group. No apparent pattern of symptoms was observed in either group.

No personal exposures to carbon monoxide of 9 ppm or above were measured at the WSL operation. Therefore, the formula from the NIOSH criteria document for reducing MC exposures in the presence of CO would not be applicable.

Significant carbon monoxide generation was observed from several lift trucks in the Shipping Department, implying the need for the company to evaluate CO exposure in detail.

VIII. RECOMMENDATIONS

The following recommendations are made in the interest of improving workplace health and safety. Most of these recommendations reflect conditions observed at the time the survey was conducted in March 1986, and are reiterations of recommendations made in previous letter reports. The company management has reported that most of the recommended actions were already in effect at the time of the NIOSH survey or have been implemented since then.

1. Individual fans should continue to be provided for cooling and personal ventilation for WSL operators. Fans should be directed in a manner which ensures that air is constantly moving across the breathing zone of the WSL operator.

2. Mechanics should address WSL operator concerns about clogged or poorly flowing reservoirs immediately. If possible, a preventive maintenance schedule should be enacted to obviate any need for repair.

3. Skin protection is needed to prevent drying of skin of WSL operators. Protective gloves or effective barrier creams could be considered. Gloves impermeable to methylene chloride should be worn by WSL operators when they are cleaning the MC application equipment. Consideration must also be given to preventing safety hazards which may be caused by entanglement of protective gloves in moving machinery.

4. Appropriate respirators should be provided to all employees who request them. Respirators should be donned when cleaning the MC application equipment. Because the odor threshold of methylene chloride is higher than the recommended exposure limit, NIOSH does not recommend air-purifying type respirators. The user would not have adequate warning if the respirator should leak, become saturated, or fail, giving the user a false sense of security. However, if such air-purifying respirators are used, they should be inspected frequently and the cartridge changed after each use. Half-face cartridge type respirators only offer a protection factor of 10, limiting the utility of such respirators for emergency or spill situations where the airborne concentrations are high or unknown. For situations where very high airborne vapor concentrations might be encountered, such as in confined spaces or during a major spill, a Type C supplied-air respirator or a self-contained breathing apparatus would be required.

5. Employees should be instructed to immediately remove any clothing that becomes wetted or soaked with methylene chloride.

6. In order to minimize any unforeseen hazard which may be attributable to carbon monoxide, smoking should not be permitted in the workplace.

7. All personnel working with the WSL process should be informed in writing of the proper procedures to be enacted should any spill of methylene chloride (e.g. overflow, splash, or leak) occur.

8. The carbon monoxide exposure in the Shipping Department warehouse should be investigated more thoroughly. Personal sampling of several lift truck drivers should be conducted.

9. Since transient high carbon monoxide readings seem to be associated with some of the trucks, problem trucks should be identified and adjusted or modified to reduce CO emission.

10. If lift truck modifications, proper engine tuning, or new replacement trucks do not sufficiently reduce carbon monoxide exposures in the warehouse, additional roof fans should be installed to improve warehouse ventilation.

The company management has reported a number of actions taken in response to NIOSH recommendations made in previous letter reports. Piping design changes have been made to the WSL machines to reduce the potential for system clogging and overflow. Chemical protective gloves are provided to operators for use during maintenance. Respirators and employee training continue to be provided. The plant has leased 38 new forklift trucks for use in the Shipping Department. Periodic tests are performed on these trucks to monitor and control the levels of carbon monoxide in the exhaust gases.

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X. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

1. Owens-Illinois Glass Container Division, Hapeville, GA
2. Glass, Pottery, Plastics & Allied Workers Union, National Office
3. GPPAW, Local Union No. 101
4. U.S. Department of Labor, OSHA, Region IV
5. NIOSH Regional Office - Atlanta, Georgia
6. Appropriate agencies of the State of Georgia

For the purpose of informing the approximately 25 "affected employees", the employer will promptly "post" this report for a period of thirty (30) calendar days in a prominent place(s) near where the affected employees work.

XI. REFERENCES

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TABLE 1

Carbon Monoxide Samples

Owens-Illinois Glass Co.
Hapeville, Georgia
HETA 86 - 130

April 1 - 2, 1986

Location of Sample	Type of Sample (personal or area)	Carbon Monoxide Concentration (ppm)
April 1, 1986, 3pm-11pm Shift:		
WSL Operator - A1 Line	P	1.8 ppm
WSL Operator - A2 Line	P	Not Measured equipment malfunction
WSL Operator - E1 Line	P	3.8 ppm
Relief WSL Operator	P	2.0 ppm
Mechanic for A1/A2	P	8.8 ppm
Center of Warehouse (Shipping Department)	A	17.0 ppm
April 2, 1986, 7am-3pm Shift:		
WSL Operator - A1 Line	P	0.1 ppm
WSL Operator - A2 Line	P	3.1 ppm
WSL Operator - E1 Line	P	5.1 ppm
Relief WSL Operator	P	3.2 ppm
Mechanic for A1/A2	P	6.5 ppm
Stretch Wrap Operator (Shipping Dept. Warehouse)	P	27.0 ppm

OSHA Permissible Exposure Limit (8 hour average) = 50 ppm
NIOSH Recommended Exposure Limit (8 hour average) = 35 ppm

TABLE 2

Methylene Chloride Sample Results

Owens - Illinois Glass Company
Hapeville, Georgia
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April 1 - 2, 1986

Sample Location	Sample No.	Type of Sample (personal or area)	Methylene Chloride Concentration (ppm)
April 1, 1986 3pm - 11pm Shift:			
WSL Operator - A1 Line (Selecting Dept.)	1	P	N.D.
	2		0.5
	3		N.D.
Shift Average			0.2
WSL Operator - A2 Line (Selecting Dept.)	1	P	0.9
	2		1.1
	3		0.7
Shift Average			0.9
WSL Operator - E1 Line (Selecting Dept.)	1	P	6.7
	2		3.4
	3		1.3
Shift Average			3.6
WSL Relief Operator (Selecting Dept.)	1	P	2.0
	2		1.6
	3		3.7
Shift Average			2.4
Zone Mechanic (Selecting Dept.)	1	P	N.D.
	2		N.D.
	3		N.D.
Shift Average			N.D.
Warehouse Area (Shipping Dept.)	1	A	N.D.
	2		N.D.
Shift Average			N.D.

TABLE 2 - Continued

Sample Location	Sample No.	Type of Sample (personal or area)	Methylene Chloride Concentration (ppm)
April 2, 1986 7am - 3pm Shift:			
WSL Operator - A1 Line (Selecting Dept.)	1 2 3	P	N.D. N.D. 0.5
Shift Average			0.2
WSL Operator - A2 Line (Selecting Dept.)	1 2 3	P	2.0 1.4 2.0
Shift Average			1.8
WSL Operator - E1 Line (Selecting Dept.)	1 2 3	P	3.4 8.9 7.9
Shift Average			6.9
WSL Relief Operator (Selecting Dept.)	1 2 3	P	1.3 4.3 0.5
Shift Average			1.7
Zone Mechanic (Selecting Dept.)	1 2 3	P	2.2 N.D. 3.1
Shift Average			1.7
Stretch Wrap Operator (Shipping Dept.)	1 2	P	N.D. N.D.
Shift Average			N.D.

OSHA Permissible Exposure Limit (8-hour average) = 500 ppm
NIOSH Recommended Exposure Limit (1976) (8-hour average) = 75 ppm
ACGIH Threshold Limit Value (1985) (8-hour average) = 100 ppm

Recent animal bioassay data indicate carcinogenic potential (NTP 1985). Exposure to potential carcinogens should be reduced to the lowest technically feasible level.

N.D. = none detected in the sample

TABLE 3

SUMMARY OF QUESTIONNAIRES ADMINISTERED TO EXPOSED AND NON-EXPOSED EMPLOYEES AT OWENS-ILLINOIS HETA 86-130

Number of exposed workers (includes WSL operators and gauge mechanics)

= 21

Number of non-exposed workers (includes shipping department employees)

= 23

Responses are number of employees per group which marked either "Every day" or "Often" as responses to the following questions:

	EXPOSED	NOT EXPOSED
Are you HAPPY with YOUR JOB?	12 (57%)	8 (35%)
Do you USE SOLVENTS on your job?	14 (67%)	5 (22%)
Is there a SOLVENT ODOR associated with your job?	14 (67%)	5 (22%)
Do you think that you are GETTING SICK from your work?	0 (0%)	4 (17%)
Have you felt HIGH or GOOFY from the chemicals you work with?	0 (0%)	2 (9%)
Have you had HEADACHES more often than usual?	5 (24%)	3 (13%)
Have you noticed that you can't SMELL as well as you used to?	4 (19%)	2 (9%)
Have you noticed a LOSS OF APPETITE?	0 (0%)	1 (4%)
Have you had an unexplained WEIGHT LOSS?	0 (0%)	1 (4%)
Does food TASTE any different lately?	2 (10%)	2 (9%)
Have your EYES been WATERING or FEELING ITCHY?	4 (19%)	3 (13%)

Does your NOSE or SINUSES run during work when you aren't sick?	6 (29%)	5 (22%)
Do you notice that you are getting to be SHORT OF BREATH?	2 (10%)	5 (22%)
Have you been COUGHING ALOT?	3 (14%)	4 (17%)
Have you had CHEST PAIN or TIGHTNESS?	1 (5%)	0 (0%)
Have you had DIFFICULTY FALLING ASLEEP?	3 (14%)	4 (17%)
Have you become TIRED more easily than usual for the amount of work and play you normally do?	3 (14%)	4 (17%)
Have you been SLEEPING more than is usual for you?	2 (10%)	3 (13%)
Do you notice that you SWEAT for no particular reason?	2 (10%)	3 (13%)
Have you FELT DEPRESSED for no particular reason?	3 (14%)	3 (13%)
Have you FELT IRRITABLE for no particular reason?	0 (0%)	1 (4%)
Have you had MOOD SWINGS that seem hard to explain?	1 (5%)	2 (9%)
Have you been MORE EXCITABLE than usual?	0 (0%)	3 (13%)
Have you had NAUSEA that is not caused by something you ate or drank?	3 (14%)	1 (4%)
Have you had INDIGESTION?	2 (10%)	3 (13%)
Have you felt WEAK for no apparent reason?	1 (5%)	1 (4%)
Have you been feeling weak in your ARMS or HANDS?	2 (10%)	3 (13%)

Have you been feeling weak in your LEGS or FEET?	2 (10%)	0 (0%)
Have you had any NUMBNESS or TINGLING in your TOES?	2 (10%)	0 (0%)
Have you had any NUMBNESS or TINGLING in your FINGERS?	1 (5%)	0 (0%)
Have you been bothered by INCOORDINATION or LOSS OF BALANCE?	1 (5%)	0 (0%)
Have you had TROUBLE REMEMBERING things?	1 (5%)	3 (13%)
Have your RELATIVES TOLD YOU that you have TROUBLE REMEMBERING things?	1 (5%)	1 (4%)
Have you had to begin to MAKE NOTES in order to REMEMBER THINGS?	3 (14%)	3 (13%)
Have you had DIFFICULTY CONCENTRATING?	0 (0%)	2 (9%)
Does your HEART SKIP A BEAT even if you are not exerting yourself?	1 (5%)	0 (0%)
Have you had any DIFFICULTY DRIVING home from work?	0 (0%)	1 (4%)
Has your SKIN been DRY or SCALY?	2 (10%)	3 (13%)
Do you SMOKE cigarettes?	YES/NO	YES/NO
	12/9	12/11
	(57%)	(52%)