HETA 92-0158-2369
NOVEMBER 1993
OLYMPIC PACKAGING INC.
MADISON, WISCONSIN

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SUMMARY

In February 1992, an authorized representative of the United Paperworkers International Union requested that the National Institute for Occupational Safety and Health (NIOSH) conduct a health hazard evaluation at Olympic Packaging Incorporated in Madison, Wisconsin. Specifically, NIOSH was asked to evaluate the exposures to chemicals and starch dust used at the facility, and to evaluate respiratory problems experienced by the workers.

In July 1992 and March 1993, NIOSH conducted medical and industrial hygiene investigations. The medical investigation included interviews with selected employees and a review of the Occupational Safety and Health Administration (OSHA) 200 Injury and Illness Logs to determine the incidence of work-related health problems and lost work days. The environmental assessment included walk-through and air sampling surveys, and collection of bulk samples for laboratory analysis. The air sampling evaluated exposures to several volatile organic compounds and starch dust.

The NIOSH medical investigator conducted confidential interviews with 28 employees. The most common symptoms were dry or irritated eyes, stuffy nose or sinus congestion, dry or irritated throat, cough, and dry skin. Nearly all employees believed that the plant was dusty as a result of paper dust and the use of spray powder on the offset presses.

Air sampling results indicated that the concentrations of the individual chemicals were well below the OSHA Permissible Exposure Limits, NIOSH Recommended Exposure Limits, and American Conference of Governmental Industrial Hygienists Threshold Limit Values. However, the equivalent exposure criteria for organic solvents was one (unity) in the mix room of the rotogravure department, indicating that there is a potential for the criteria to be exceeded on days when the presspersons spend a major portion of the workshift in this room. Also, a number of safety hazards were identified, including inadequate eye and skin protection, and failure to meet the OSHA requirements for respiratory protection and hazard communication programs.

NIOSH investigators concluded that employees were exposed to potentially hazardous concentrations of organic solvents in the rotogravure department. In an effort to reduce workers' exposures, recommendations, such as improved local exhaust ventilation, implementation of an effective respiratory protection program, and utilization of appropriate personal protective equipment, are provided in the Conclusions and Recommendations section of this report.

KEYWORDS: SIC 2657 (Folding paperboard boxes including sanitary), ethylene glycol monobutyl ether (EGBE or 2-butoxyethanol), toluene, xylene, n-propyl acetate, 1,1,1-trichloroethane (1,1,1-TCE), ethyl acetate, methyl isobutyl ketone (MIBK), acetone, isopropanol, starch dust, equivalent exposure criterion

INTRODUCTION

On February 21, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of the United Paperworkers International Union, Local 1202 to conduct a health hazard evaluation at Olympic Packaging Incorporated in Madison, Wisconsin. The union representative requested an evaluation of the chemicals and starch spray powders used throughout the facility. Worker complaints of eye irritation, sinus infections, and respiratory problems were noted in the request.

An initial site visit was performed on July 21-22, 1992; it included a medical and an industrial hygiene survey. The medical evaluation consisted of confidential employee interviews and reviews of the Occupational Safety and Health Administration (OSHA) 200 Injury and Illness Logs. A walk-through survey was performed to review work practices and assess the industrial hygiene and safety conditions. Bulk, area, and personal air samples were also collected; however, sampling was performed when production was relatively low and when the main source of dust generation was not operating. An interim report including preliminary results and recommendations was submitted to the company and the union in January 1993.

In order to more adequately assess the workers' exposures, it was necessary to make a follow-up visit to perform air monitoring during full production. On March 16-17, 1993, a follow-up environmental visit was conducted during normal manufacturing activities in the winter. Personal breathing zone air samples for total dust and organic solvents were collected.

FACILITY DESCRIPTION AND BACKGROUND

Olympic Packaging Incorporated, a manufacturer of printed cartons for consumer goods, employs approximately 200 people working over three shifts. Of these, 150 are production workers. A schematic diagram of the facility is shown in Figure 1.

Rolls of paperboard are delivered via trucks or train cars and are either distributed to the sheeter or rotogravure press. The sheeter cuts the paperboard to the specified length and stacks 48-60 inch high loads onto skids which are taken to the offset presses. In the offset presses, water-based inks and varnish are applied to the paperboard. A starch powder is also sprayed onto each sheet to prevent the sheets from adhering together when stacked. After waiting 24 hours for the ink to fully dry, the loads are taken to the aerator where the sheets are aligned and the spray powder is blown out. The loads then proceed to the die cutting department. Counters, which define the dimensions of the carton, are prepared and placed within the die cutting machines. These machines stamp the impression of the flat cartons, and align and stack the loads. The die cutting machines do not fully cut the flat cartons, but rather make perforated edges. The excess material is removed and the flaps of the cartons are separated using hand-powered pneumatic jack hammers. The flat cut-out cartons are then taken to the finishing area. In this department, the flat boxes are folded and glued together to form complete cartons.
The other portion of the paperboard is distributed to the rotogravure press. The rotogravure is a web-feed printing press that prints up to five colors (using solvent-based inks) and die cuts the paperboard in one continuous process. From the rotogravure, the flat cartons are transferred to the finishing area where the cartons are assembled.

EVALUATION PROCEDURES

In order to evaluate reported health problems and potential occupational hazards, medical and industrial hygiene evaluations were performed. The medical evaluation included
medical interviews with selected employees and a review of the OSHA 200 Injury and

Illness Logs to determine the incidence of work-related health problems and lost work days. The environmental assessment included a walk-through evaluation of the work practices and industrial hygiene and safety conditions of the plant, and monitoring for airborne contaminants.

Medical Investigation

Private medical interviews were conducted with 28 employees. The management of Olympic Packaging provided NIOSH investigators with a list of employees working during the week of the site visit. A random sample of 22 employees on each of the three shifts was selected by choosing every fourth name on the list. Six other employees were selected from a list, provided by the union representative, of individuals who had expressed an interest in discussing their work-related health concerns. From the interviews, information was gathered about workplace conditions, work practices including the use of personal protective equipment, and the frequency of medical symptoms possibly related to dust and solvent exposures.

Although cumulative trauma concerns were not reported in the original request, problems mentioned by employees prompted the NIOSH investigators to review the OSHA 200 Injury and Illness Logs to assess temporal and spatial patterns of work-related illnesses and injuries. Data were obtained for January 1989 through June 1992.

Environmental Methods

Air Monitoring

Starch Dust

Area and personal breathing zone air samples for starch dust were collected on pre-weighed 37-millimeter (mm), 5 micron (µm) pore size, polyvinyl chloride membrane filters in closed-face cassettes according to the NIOSH Method 0500.[1] The cassettes were connected via Tygon® tubing to Gillian Hi Flow Sampler® battery-operated personal sampling pumps. Sample air was drawn through the filters at a flow rate of 2 liters per minute (ℓ/min). After sampling, the filters were removed from the cassettes and weighed. The analytical limit of detection is 0.2 milligrams (mg) of particulate material per sample, which equates to a minimum detectable concentration of 0.026 milligrams per cubic meter (mg/m^3) for an average volume of 764 liters.

The sampling pumps were calibrated on-site prior to and after sampling using the Kurz Pocket Flow Calibrator™ mass flowmeter, which was calibrated against a primary standard. For subsequent calculation of sample volumes, the mean pre- and post sampling flow rates were used. A minimum of two field filter blanks for every 10 samples collected were prepared and submitted with the sample set.

Organic Solvents

Bulk, personal breathing zone, and area air samples for organic solvents were collected using charcoal tubes as the collection media. The charcoal tubes were connected via Tygon® tubing to Gillian Lo Flow Sampler® battery-operated personal sampling pumps. Air was sampled through the tubes at a nominal flow rate of 0.2 ℓ/min for qualitative air samples and 0.05 ℓ/min for quantitative air samples. After sampling, the charcoal tubes were removed and desorbed in carbon disulfide. Five bulk air samples were qualitatively analyzed for organic compounds using gas chromatography-mass spectrometer (GC-MS). Based on the results of the bulk samples, samples were quantitatively analyzed for ethylene glycol monobutyl ether (EGBE or 2-butoxyethanol), toluene, xylene, n-propyl acetate, 1,1,1-trichloroethane (1,1,1-TCE), ethyl acetate, methyl isobutyl ketone (MIBK), acetone, and/or isopropanol using the NIOSH Method 1400[1] with modifications. The quantitative samples were analyzed using gas chromatography-flame ionization detection (GC-FID). The analytical limit of detection for NIOSH Method 1400 is 0.01 mg/analyte.

The sample pumps were calibrated prior to and after sampling using the Gillian Gilibrator®, which was calibrated against a primary standard. For subsequent calculations of sample volumes, the mean pre- and post flow rates were used. A minimum of 10% of the sampled charcoal tubes were prepared and submitted as field blanks with the sample set.

Bulk Samples

Five bulk liquid solvents, which are used throughout the facility, were collected in 10 milliliter (ml) vials and submitted for qualitative analysis of volatile organic compounds. Portions of each of the bulk samples were diluted with carbon disulfide and analyzed by GC-MS. Two bulk settled dust samples were also collected in the finishing department and qualitatively analyzed for the solvents associated with the bulk liquids to determine whether the particulate matter was trapping and "off-gassing" the solvents. The dust samples were heated in the ATD 400 automatic thermal desorber to 50 degrees Celsius (the minimum operating temperature of the system) for 10 minutes and analyzed by gas chromatography-mass selective detector (GC-MSD).

EVALUATION CRITERIA

General Guidelines

As a guide to the evaluation of the hazard 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, 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 source of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs),[2] 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[3] and 3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs).[4] The OSHA standards may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. It should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Starch Dust

Starch dust usually has little adverse effect on the lungs, although it may aggravate certain pre-existing lung conditions.[5] Under the OSHA standard regulating occupational exposure to total starch dust, the PEL is 15 mg/m^3 for an 8-hour (hr) TWA. The NIOSH REL and ACGIH TLV® are 10 mg/m^3 as an 8-hr TWA.[2-3] Both the OSHA PEL and NIOSH REL have an exposure limit of 5 mg/m^3 as an 8-hr TWA for the respirable fraction of the starch dust.[2,4]

Starch is also considered to be a fire and explosion hazard. The National Fire Protection Association has requirements regarding structural features, ventilation, explosion protection and equipment, and many other topics for the manufacturing and handling of starch.[6]

Organic Solvents

Toluene

Toluene is a colorless, aromatic organic liquid. It is a solvent typically found in paints, coatings, gasoline, and other petroleum solvents, and is used as a raw material in the synthesis of organic chemicals, dyes, detergents, and pharmaceuticals.

Inhalation and skin absorption are the major routes of exposure. Toluene can cause acute irritation of the eyes, respiratory tract, and skin. Since it is a defatting solvent, repeated or prolonged skin contact will remove the natural lipids from the skin and cause drying, fissuring, and dermatitis.[7]

The main effects associated with exposure to toluene are central nervous system (CNS) depression and neurotoxicity. Studies have shown that subjects exposed to 100 parts per million (ppm) of toluene complained of eye and nose irritation, and in some cases, headache, dizziness, and a feeling of intoxication.[8-9] No symptoms were noted below 100 ppm in these studies. However, concentrations above 200 ppm can cause dizziness, drowsiness, headache, nausea, vomiting, and unconsciousness. There are a number of reports of neurological damage due to deliberate sniffing of toluene-based glues, resulting in motor (muscle) weakness, intention tremor, ataxia (staggering), and cerebral atrophy (degeneration of the brain). Recovery is complete; however, permanent impairment may occur after prolonged glue-sniffing. Exposure to extremely high concentrations of toluene may cause mental confusion, loss of coordination, and unconsciousness.[10-11]

The OSHA PEL for toluene is 200 ppm, whereas the NIOSH REL is 100 ppm for an 8-hour TWA.[4,12] NIOSH has also set a recommended STEL of 150 ppm for a 15-minute sampling period.[2] More recently, ACGIH has lowered their exposure criteria to 50 ppm for an 8-hour TWA. This value was based on prevention of transient headaches, irritation, and reductions in cognitive responses reported in humans at levels greater than or equal to 40 ppm.[13] Also, the ACGIH TLV® carries a skin notation, indicating that cutaneous exposure contributes to the overall absorbed inhalation dose and thus, to potential systemic effects.[3]

Acetates

Occupational exposures to ethyl, isopropyl, and n-propyl acetates may cause eye and upper respiratory irritation. At high concentrations, all produce narcosis in animals and are suspected to cause similar effects in humans. In rare cases, exposure to ethyl acetate may cause sensitization, resulting in inflammation of the mucous membranes and in eczematous skin eruptions (red, blistery, scaly rash).[7]

The NIOSH REL, OSHA PEL, and ACGIH TLV® for ethyl acetate are 400 ppm for an 8-hr TWA exposure.[2-4] The OSHA and ACGIH exposure criteria for isopropyl acetate are 250 ppm for an 8-hr TWA.[3,4] However, NIOSH did not adopt these exposure levels as its REL. After a limited review of the toxicity of isopropyl acetate, NIOSH concluded that adverse health effects could occur at the proposed OSHA PEL, so therefore, a lower PEL for this chemical would be more appropriate to protect workers.[14] The NIOSH REL, OSHA PEL, and ACGIH TLV for n-propyl acetate are 200 ppm for an 8-hr TWA.[2-4] NIOSH and ACGIH have set a 15-minute STEL at 250 ppm.[2,3]

Other Organic Solvents

Acetone, EGBE, isopropanol, MIBK, 1,1,1-TCE, and xylene are organic solvents which are irritants to the eyes, mucous membranes, and upper respiratory tract. In addition, organic solvents can cause acute and chronic neurotoxic effects. Acute neurotoxic effects include headaches, dizziness, weakness, poor concentration, impaired balance, confusion, loss of consciousness, and respiratory depression. Other observed effects from excessive exposure include peripheral neuropathies and CNS disorders.[7]

The relevant evaluation criteria for the solvents are listed in the table in ppm.

EVALUATION CRITERIA

	NIOSH		OSHA	ACGIH	
	REL	STEL	PEL	TLV	STEL
Acetone	250	--	1000	750	1000
EGBE	5*	--	50	25*	--
Isopropanol	400	500	400	400	500
MIBK	50	75	100	50	75
1,1,1, TCE	350[c]	--	350	350	450
Xylene	100	150	100	100	150

-- No established exposure limit
* Skin notation, indicating that the cutaneous route contributes to the overall exposure
[c] Ceiling limit, not to be exceeded at any time.

Equivalent exposure criterion for mixtures

Concurrent exposure to two or more hazardous substances which act upon the same target organ system should be considered as additive exposures. In the absence of contrary information, the combined effect, rather than that of individual effects, should be given primary consideration when evaluating worker exposure to substances with similar physiologic effects.

To evaluate the additive effect, the exposure level of each substance is computed as a fraction of the evaluation criterion for that substance. If the sum of the fractions exceeds unity (1), the worker is considered to be overexposed to that mixture of substances.[3,4]

When evaluating exposure to chemical mixtures, it is important to note that synergistic action or potentiation may occur with some combinations of atmospheric contaminants. Synergism is a phenomenon in which the combined effect of two or more chemicals is much greater than the simple sum of the effects from each exposure. Potentiation is the case where a chemical agent does not, by itself, have a toxic effect on an organ system, but when present with exposure to another chemical agent makes that agent much more toxic.[15] Applying the equivalent exposure evaluation criterion for synergistic or potentiating cases may underestimate the health effect resulting from exposure to chemical mixtures.

For purpose of evaluating exposures, the effects of toluene, xylene, acetone, EGBE, ethyl acetate, isopropyl acetate, isopropanol, n-propyl acetate, MIBK, and 1,1,1-TCE were considered additive. Since these substances all have the ability to produce symptoms related to CNS depression, the equivalent exposure criterion for additive effects of multiple chemicals was used.

RESULTS AND DISCUSSION

Medical Evaluation

The interviewed employees ranged in age from 26 to 54 years (mean=39 years) and in seniority from two months to 33 years (mean=13 years). Twenty (71%) were male and eight (29%) were female. Symptoms indicative of mucous membrane irritation were frequently reported by these employees (refer to Table 1). The most common symptoms were dry or irritated eyes (68%), stuffy nose or sinus congestion (61%), dry or irritated throat (54%), cough (36%), and dry skin (36%). Most employees reported that these symptoms improved when they left work. Many reported that the symptoms were worse in the winter.

Some common concerns about the work environment were raised by the interviewed employees, and specific problem areas in the plant were identified. Nearly all employees believed that the plant was dusty as a result of paper dust and the use of starch powder on the offset presses. Specific dust-generating processes mentioned were the aerator and the use of emery on the folding glue machines. Other problems mentioned in the interviews were chemical odors in the rotogravure department and extreme cold in the baler area during the winter.

Review of the OSHA 200 Logs revealed that cumulative trauma disorders accounted for 63 (61%) of 104 entries. Among all cumulative trauma disorders, incidents involving the back (28) and hand/wrist (18) were most frequent. Analysis of temporal trends showed that although the number of hand/wrist injuries declined between 1989 and 1992, the number of back injuries remained fairly constant. Of the 28 back injuries, eight occurred while employees were working on the pneumatic jack hammer.

Environmental Evaluation

Starch Dust

The area and personal air sampling results for starch dust are presented in Tables 2, 3, and 4. Eight area samples were collected, and airborne concentrations for starch dust ranged from 0.16 to 3.03 mg/m^3. The area samples were located in close proximity to the points where the highest concentration of dust were emitted and where workers were present a substantial amount of time. However, these samples may overestimate the workers' true exposure since workers spent time in lower exposure areas.

Twenty-five personal breathing zone samples, collected for total starch dust, were analyzed gravimetrically. Eight-hr TWAs ranged from 0.08 to 3.47 mg/m^3. With the exception of the aerator operator, all workers performed continuous job tasks and therefore, similar exposures to those measured during the sampling period were assumed for the time period not sampled. Typically, this is a "conservative" approach, erring on the side of health and safety. The full-shift TWA for the aerator operator was calculated assuming a zero exposure during non-sampled periods since this employee performs a number of different job tasks throughout the day. All concentrations measured were well below the NIOSH REL, ACGIH TLV®, or OSHA PEL for starch dust.

Volatile Organic Compounds

Five qualitative air samples were collected in the offset press, rotogravure, die cutting, and finishing areas. The major components identified by the GC-MS were toluene, xylene, acetone, EGBE, ethyl acetate, isopropyl acetate, isopropanol, n-propyl acetate, MIBK, and 1,1,1-trichloroethane. Area and personal samples were submitted for quantitative analysis using GC-FID and the results are presented in Table 5 and 6.

Eleven air samples were collected to assess workers' exposures to toluene, xylene, acetone, EGME, ethyl acetate, isopropyl acetate, isopropanol, n-propyl acetate, MIBK, and/or 1,1,1-TCE, and the 8-hour TWA exposures were calculated assuming a continuous exposure during the period of time which was not sampled. The most noteworthy results were for toluene and acetates. Toluene levels ranged from 0.46 to 33.8 ppm. The highest concentrations of ethyl acetate, isopropyl acetate, and n-propyl acetate were 39.6 ppm, 22.1 ppm, and 33.8 ppm, respectively. The highest concentrations were measured in the personal breathing zone of the rotogravure assistant pressperson or in the area sample collected in the mix room in the rotogravure department, where the majority of solvents are used. Individually, none of the samples was in excess of the OSHA PEL, NIOSH REL, and ACGIH TLV. However, since all of these solvents are volatile organic compounds and affect the central nervous system in a similar manner, a equivalent exposure to the solvent mixture was calculated.

The area and personal equivalent exposures are also shown in Tables 5 and 6. The equivalent exposures for area samples collected in the mix room were 1.0 and 0.3. If the equivalent exposure value exceeds 1.0 (unity), the solvent mixture exposure is considered to exceed the recommended limit. Workers' exposures vary and are contingent on the job tasks performed. The amount of time that the workers are in this poorly ventilated room contributes substantially to their exposures. The workers' equivalent exposures ranged from 0.1 to 0.9. The highest equivalent exposure to the solvent mixture was collected on the rotogravure assistant pressperson, who spends a majority of the workday in the mix room. On the follow-up survey (Table 6), the equivalent exposure of the rotogravure assistant pressperson and mix room decreased. It is believed that the reason for this reduction in exposure was due to the fact that the worker spent less than half the amount of time in the mix room than on a typical workday. This variation of exposures indicates that there is a potential for the equivalent exposure criteria to be exceeded on days when the pressperson spends a major portion of the workshift in the mix room.

Bulk Samples

Five bulk liquid samples of chemicals used throughout the facility were analyzed and found to contain solvents similar to those detected in the qualitative air samples, in varying amounts. Two bulk dust samples from the finishing department were also analyzed and the major compounds detected in these bulk dust samples were n-paraffins and other aliphatic hydrocarbons, probably components of the cardboard cartons. There was no indication of any solvents present in the dust.

CONCLUSIONS AND RECOMMENDATIONS

The health hazard evaluation was initiated as a result of concerns regarding exposures to dust and chemicals used in connection with the printing processes. The major concerns were eye and respiratory irritation. The environmental evaluation revealed a potential for over-exposure from organic solvent mixtures in the rotogravure department and identified a number of health and safety problems throughout the facility. The employee exposures should be reduced by improved industrial hygiene. In particular, exposures can be reduced by installing engineering controls, improving worker training, and providing and enforcing the use of appropriate protective clothing. Specific recommendations regarding general safety and chemical exposures are presented below.

1. Currently, Olympic Packaging Inc. has an exhaust system located at floor level to remove airborne contaminants which are heavier than air. Unfortunately, this design is ineffective in the removal of airborne contaminants since contaminants are evenly mixed within air.[16] Therefore, a local exhaust ventilation system should be installed to reduce the solvent exposures in the mix room. A firm specializing in engineering controls should be consulted to design and install the ventilation system. The installation of this system should use standardized design practices such as those provided in the ACGIH's, *Industrial Ventilation, 20th Edition, A Manual of Recommended Practice.* In the interim, respiratory protection (half-mask respirator with organic vapor cartridges) should be provided to the rotogravure assistant pressperson. Olympic Packaging Inc. must meet the minimum requirements set forth by the U.S. Department of Labor, OSHA in the respiratory protection standard (29 CFR 1910.134), which includes written standard operating procedures, medical surveillance, fit-testing, worker training, and all other aspects of the program.[4]

2. The efficacy of engineering controls should be tested by conducting industrial hygiene monitoring in the mix room and on the assistant pressperson. This monitoring should document a reduction of the chemical exposures within acceptable criteria.

3. Eye trauma from foreign bodies and splashes are preventable. Olympic Packaging Inc. should institute and enforce a program requiring the use of eye protection. Safety glasses should be required in all production areas and chemical splash goggles should be required in the mix room and whenever chemicals are being transferred from one container to another.

4. Appropriate personal protective clothing should be used in the rotogravure mix room. According to Forsberg and Mansdorf's *Quick Selection Guide to Chemical Protective Clothing*, natural rubber gloves should not be used for toluene, xylene, MEK, or 2-butoxyethanol. Polyvinyl chloride (PVC), Teflon™, or Viton™ gloves are recommended when handling toluene, and xylene. For MEK, butyl rubber or Viton™ gloves are recommended. Butyl rubber or Viton™ gloves should be used when handling 2-butoxyethanol and ethyl acetate.[17] Aprons and gloves should be worn whenever mixing and/or pouring chemicals, and should be replaced frequently. As part of the hazard communication program, the employees should be trained on the specific type of glove and apron which should be worn for specific chemical hazards.

5. Labeling of chemicals, worker training, and other aspects of the hazard communication should be improved. Olympic Packaging Inc. is required to meet all provisions of the hazard communication standard (29 CFR 1910.1200) as set forth by OSHA. Chemical containers should be labeled. The labels should identify the contents and any known hazards that are associated with that material. The material safety data sheet (MSDS) file is another aspect of OSHA's hazard communication standard. The MSDS file appeared to contain all of the chemicals in use throughout the facility. However, the current method of arranging the MSDSs by the chemical company name is confusing. The filing system should be re-organized in a manner which will allow the workers to locate any MSDS easily.

6. Open buckets should not be used as chemical containers. Olympic Packaging Inc. is required to use containers of the appropriate design, construction, and capacity as set forth by the OSHA standard 1910.106 for flammable and combustible liquids.

7. The use of compressed air to blow dust off the equipment and dry sweeping should be discontinued since these practices may produce inhalation and eye injury hazards. A vacuum system, preferably with a high-efficiency particulate air (HEPA) filter, should be used.

8. Although a noise survey was not conducted as part of this survey, there were a number of deficiencies noted regarding the requirements in the OSHA noise standard (29 CFR 1910.95). Periodic noise surveys, which include both sound level measurements and dosimetry, should be performed to determine the noise levels. Signs must be posted to distinguish the areas where hearing protection is required. Olympic Packaging Inc. should require the use of hearing protection devices in areas which exceed a noise level of 85 decibels on an A-weighted scale. Workers should be trained on the effects of noise exposure and hearing loss, and encouraged to reduce both occupational and recreational noise to prevent noise-induced hearing loss. The noise standard requires employee notification of both the sampling and audiometric results.

9. An ergonomic evaluation of the pneumatic jack hammer operation should be conducted.

10. In order to address general health and safety issues, a safety committee which includes both employer and employee representatives should be established.

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Copies of this report have been sent to:

1. United Paperworkers International Union, Local 1202
2. Olympic Packaging Incorporated
3. OSHA Region V

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Table 1

Frequency of Reported Symptoms Among 28 Employees*
Olympic Packaging, Inc.
Madison, Wisconsin

July 21-22, 1992

Symptom	No.	%
Eye Irritation	19	68
Stuffy Nose/Sinus Irritation	17	61
Throat Irritation	15	54
Dry Skin	10	36
Cough	10	36
Sneezing	9	32
Shortness of Breath	8	29
Dizziness	7	25
Chest Tightness	5	18
Wheezing	5	18
Headache	5	18

* Only symptoms reported by five or more employees are listed.

Table 2

Air Sampling for Starch Dust
Olympic Packaging Inc.
Madison, Wisconsin

July 21, 1992

Location/Job Category	Sample Time (minutes)	Concentration (mg/m^3)
Area: 2-Color Offset Press; Delivery End	350	0.38
Area: Aerator	345	0.23
Area: Folding Gluer Machine #2	350	0.38
Area: Baler	335	0.16
Area: Die Cutting; Bobst #65	335	0.16
Aerator Operator	150	0.39
Area: 7-Color Offset Press; Delivery End	330	3.03
Area: Sheeter	305	0.44
Minimum Detectable Concentration (MDC)		0.07
EVALUATION CRITERIA		
OSHA PEL		15
NIOSH REL		10

Table 3

Air Sampling for Starch Dust
Olympic Packaging, Inc.
Madison, Wisconsin

July 22, 1992

Job Title/Location	Sample Time (minutes)	Concentration (mg/m^3)
Operator; Baler	345	0.43
Packer; Folding Gluer Machine #3	455	0.93
Operator; Folding Gluer Machine #3	455	0.70
Swifty Feeder; Folding Gluer Machine #4	455	0.30
Area: Finishing Department	455	0.55
Assistant Die Cutter: Bobst #56	425	0.20
Assistant Die Cutter: Bobst #49	435	0.23
Operator; 7-Color Offset	415	0.23
Operator; 2-Color Offset Press	405	0.49
Operator; Sheeter	485	0.08
Minimum Detectable Concentration (MDC)		0.07
EVALUATION CRITERIA		
OSHA PEL		15
NIOSH REL		10
ACGIH TLV®		10

Table 4

Air Sampling for Starch Dust
Olympic Packaging Inc.
Madison, Wisconsin

March 17, 1993

Job Title/Location	Sample Time	Concentration (mg/m^3)
Swifty Feeder; Folding Gluer Machine #4	446	0.32
Aerator Operator	464	0.74
Press Operator; Folding Gluer Machine #1	418	0.93
Catcher/Feeder; Folding Gluer Machine #1	420	0.34
Pressperson; 2-Color Offset Press, Delivery End	459	1.02
Swifty Operator; Folding Gluer Machine #4	411	0.56
Catcher/Feeder; Speed King #3	417	0.54
Swifty Catcher; Folding Gluer Machine #4	409	0.23
Die Cutter Operator; Bobst #56	455	0.52
Catcher/Feeder; Folding Gluer machine #3	408	0.76
Operator; Baler	463	3.47
Flyboy; 7-Color Offset Press	405	0.74
Die Cutter Operator; Bobst #65	460	0.15
Assistant Die Cutter; Bobst #65	454	0.17
Assistant Pressperson; 6-Color Offset Press	442	0.23
Flyboy; 6-Color Offset Press	442	0.33
Catcher/Feeder; Folding Gluer Machine #3	200	0.80
Minimum Detectable Concentration (MDC)		0.02
EVALUATION CRITERIA		
OSHA PEL		15
NIOSH REL		10
ACGIH TLV®		10

Table 5
Air Sampling for Volatile Organic Compounds
Olympic Packaging Inc.
Madison, Wisconsin
July 22, 1992

Job Category/Location	Time-Weighted-Average (ppm)										
	Toluene	Xylene	Acetone	EGBE	Ethyl Acetate	Isopropyl Acetate	Isopropanol	n-propyl Acetate	MIBK	1,1,1 TCE	Equivalent Exposure
Folding Gluer #3 Feeder/Catcher	(0.46)	<0.21	---	---	---	<0.21	<0.36	(0.44)	---	<0.16	0.0
Die Cutting Operator; Bobst #56	4.87	<0.21	<0.38	---	(0.69)	---	1.29	(0.94)	---	---	0.1
7 Color Offset Asst Pressperson	1.31	(0.19)	5.85	(0.76)	---	---	5.67	1.51	---	---	0.1
Pre-make Ready Counter	2.05	---	---	---	---	---	---	---	---	---	
Rotogravure Asst Pressperson	31.8	0.64	---	---	17.0	8.42	---	33.9	0.97	---	0.9
Mix Room Area	30.6	1.01	---	---	39.6	22.1	---	32.4	(0.44)	---	1.0
Minimum Detectable Concentration (MDC)	0.24	0.21	0.38	0.19	0.25	0.21	0.36	0.21	0.22	0.16	
Minimum Quantifiable Concentration (MQC)	0.78	0.68	1.24	0.61	0.82	0.71	1.20	0.71	0.72	0.54	
EVALUATION CRITERIA											
OSHA PEL	200	100	1000	50	400	250	400	200	100	350	
NIOSH REL	100	100	250	5	400	250	400	200	50	350	
ACGIH TLV®	50	100	750	25	400	250	400	200	50	350	

( ) = value between the MDC and MQC
--- = analysis not requested

Table 6
Air Sampling for Volatile Organic Compounds
Olympic Packaging Inc.
Madison, Wisconsin

March 17, 1993

Job Title/Location	Time-Weighted-Average (parts per million)				
	Toluene	Ethyl Acetate	Isopropyl Acetate	n-propyl Acetate	Equivalent Exposures
Rotogravure Helper	3.24	1.12	0.71	3.83	0.09
Rotogravure Assistant Pressperson	15.66	5.94	2.10	20.59	0.44
Rotogravure Catcher	4.59	1.41	0.90	5.55	0.13
Rotogravure Press Operator	2.91	0.91	0.49	3.36	0.08
Mix Room Area	10.97	4.99	1.72	9.56	0.29
Minimum Detectable Concentration (MDC)	0.14	0.15	0.13	0.13	
Minimum Quantifiable Concentration (MQC)	0.47	0.50	0.43	0.43	
EVALUATION CRITERIA					
OSHA PEL	200	400	250	200	1
NIOSH REL	100	400	---	200	1
ACGIH TLV®	50*	400	250	200	1

* = Skin notation
--- = No established limit