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NOVEMBER 1993
ACKERMAN & SONS
LITTLETON, COLORADO

NIOSH INVESTIGATORS:
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I. SUMMARY

On August 10, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request from the owner of Ackerman & Sons furniture refinishing shop to investigate methylene chloride (MeCl) exposures within the shop. An initial survey was conducted on October 10, 1992, to determine the exposures to furniture stripping solvents (primarily MeCl). An inexpensive ventilation control was then installed in two phases. The first phase included adding exhaust ventilation and enclosing only the furniture stripping booth. A second industrial hygiene survey was conducted on November 20, 1992, to determine the effectiveness of the new ventilation. The wash booth was then enclosed and exhaust ventilation added and a third survey conducted on February 10, 1993.

Initial survey results documented personal exposures (averaged over the length of the task) to MeCl ranging from 83 to 523 parts MeCl per million parts of air (ppm). Limited time was spent stripping furniture by individual workers, so 8-hour time-weighted average (TWA) concentrations of MeCl ranged from 2.4 to 177 ppm, which were below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) of 500 ppm, but above the proposed OSHA PEL of 25 ppm, and above the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 50 ppm. NIOSH considers MeCl a carcinogen and recommends that exposure be limited to the lowest feasible concentration. Exposures to methanol (MeOH) ranged from 39 to 95 ppm, which were all below the 200 ppm NIOSH REL, OSHA PEL, and ACGIH TLV.

Once the stripping booth was enclosed and ventilated, airborne concentrations of stripping compounds were greatly lower. Personal exposures to MeCl ranged from 10 to 110 ppm, and 8-hr TWAs ranged from 0.7 to 31 ppm. Area airborne concentrations were also reduced. The third survey resulted in similar exposures as the second survey, after enclosure and exhaust ventilation was also added to the wash booth. Personal exposures for MeCl ranged from 19 to 110 ppm and the 8-hr TWAs ranged from 1 to 48 ppm. MeOH levels were measured during the third survey (not during the second). Personal exposures ranged from 7.4 to 26 ppm.

Personal exposures to both MeCl and MeOH were significantly reduced by the addition of exhaust ventilation. Factors which contributed to continued higher exposures of MeCl and MeOH include poor housekeeping practices, furniture left to dry in unventilated areas, poor work practices, and limitations on design parameters for the ventilation system, (i.e., location of exhaust ports inside the booths).

On the basis of this evaluation, NIOSH investigators concluded that exposure to methylene chloride didn't exceed the OSHA standard or the ACGIH TLV. However, NIOSH considers methylene chloride to be a potential carcinogen, and therefore recommends that exposures be maintained at the lowest feasible concentration. Recommendations are included to further lower worker exposure to methylene chloride.

KEYWORDS: SIC 7641 (Reupholstery and Furniture Repair) methylene chloride, furniture stripping, methanol, exhaust ventilation.

II. INTRODUCTION

On August 10, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request from the owner of Ackerman & Sons furniture refinishing shop to investigate methylene chloride exposures within the shop. An initial survey was conducted on October 10, 1992 to determine the exposures to furniture stripping solvents (primarily methylene chloride). An inexpensive ventilation control was then installed in two phases. The first phase included adding exhaust ventilation and enclosing only the furniture stripping booth and not the wash booth. A second industrial hygiene survey was conducted on November 20, 1992 to determine the effectiveness of the new ventilation. The wash booth of the shop was then enclosed and exhaust ventilation added and a third survey conducted on February 10, 1993.

III. BACKGROUND

Ackerman & Sons is a furniture refinishing shop located in Littleton, Colorado. The shop has a full range of furniture refinishing operations, including paint stripping, furniture repair, refinishing, and recovering. The area where furniture is stripped is a separate 20 ft x 20 ft x 10 ft room which contains two elevated metal tables, each 4 ft. by 8 ft. (see Figure 1). The tables are positioned parallel to each other, about 3 feet apart. Both tables are sloped to a front corner so that all stripping solvent or wash water drain from the table surface into containers. The tables are enclosed on the back and both sides, creating a booth.

The stripping process starts with the furniture being placed on the stripping table where the stripping solvent is pumped through a hand-held brush onto the piece. The furniture is covered with the solvent and brushed to aid with paint removal. The used solvent, along with dissolved paint, flows from the table to a 5-gallon pail and is then pumped through a screen, into a hose and back to the brush. When the worker determines that the solvent is not working effectively, or the level of solvent gets too low in the pail, additional solvent is hand pumped from a 55-gallon drum of stripper solvent. The stripping solvent contains 80-90% methylene chloride (MeCl), 6-12% methanol (MeOH), and 3-7% wetting agents and wax. Periodically, the paint sludge in the pail is removed to a disposal area. Occasionally, several 5-gallon pails containing paint sludge and residual stripping solvent will accumulate in the room.

Once the paint has been removed and the excess solvent drained, the furniture is moved to the wash table where it is rinsed with high pressure water. An aqueous solution of oxalic acid may be rubbed on certain wood furniture to bleach the wood back to a more natural color. This is done after stripping and before the final rinse. After rinsing, the piece is moved to an open area of the room to dry. The wash water is drained to a series of holding tanks which filter the water before returning it to the pressure pump.

The shop employs five refinishers. Each worker may average only a few hours of stripping per week, but occasionally will strip 3-4 hours in one day. When conducting furniture stripping, the workers wear rubber aprons, full length rubber gauntlets, a face shield, and plastic upper arm covers. Workers may also wear safety glasses which they wear in the wood shop area (where they spent the majority of their time). Workers were aware of the hazards of methylene chloride and all described being able to smell the solvent. Most described occasions when they became light-headed after stripping.

DESCRIPTION OF VENTILATION SYSTEM INSTALLATION

Modifications to Booths

Both booths were modified by covering the tops and by installing curtains in the front. The top covers are shown in the accompanying sketch that describes the plan of the booths' layout (Figure 2).

Plywood (3/4-inch) was installed to cover a 2' by 8' roof area near the rear wall of the booth. An

8" by 8' strip of plywood was mounted on the roof adjacent to the front face of the booth. The remainder of the 4' wide roof was covered by two pieces of 16" wide, wire-reinforced glass. The purpose of the glass was to permit lighting of the enclosure. Fire regulations require the use of very expensive fluorescent fixtures if they are mounted in an enclosure that contains the vapors of flammable and potentially explosive liquids.

To reduce the volume of exhaust air needed to control vapor concentrations, the front of the booths were enclosed. The design had to allow the operator access to all parts of the furniture inside the booth and to allow large pieces of furniture to be loaded into and out of the enclosure.

As shown in Figure 3, the open area of the front face of the booth was enclosed by a combination of stationary and movable cloth curtains. A stationary curtain, about 20" high, was attached at the roof elevation and draped along the full 8' length of the booth enclosure opening. The curtain was cut into 6' wide strips so that furniture requiring more headroom could be passed through the front opening into the enclosure. The curtain was made of a waterproof but non-flammable material.

A 10', heavy-duty, curtain rod was mounted along the outside edge of the roof enclosure. The curtain rod was made longer than the length of the booth to facilitate moving the curtains out of the way when large furniture was moved into the booths. Two curtains, 36" wide by 64" high, were attached to hooks and rollers on the curtain rod. These curtains could be moved from side to side, allowing any portion of the front opening to be exposed but still reducing the opening to a three-foot width to allow the worker to spray stripping or wash solution onto the pieces being treated.

Booth Ventilation

By restricting the front of the booth to about three feet high by three wide, good control of the chemical vapors in the booth could be contained with an exhaust ofabout 1400 CFM (cubic feet of air per minute). That air volume provided an average indraft of about 150 fpm (feet per minute) through the front opening of the booth.

A 16-inch aluminum, spray booth type fan was mounted to an exhaust from the approximate center of the side wall of the stripping station booth, through the outside wall to the outdoors. Since the stripping liquid contains flammable chemicals, it was necessary to use non-ferrous metal fan construction and mount the fan motor on the outside of the air stream. This fan provided an adequate indraft through the front curtain opening. Final face velocity measurements ranged from 100-180 fpm, with an average of 130 fpm (no worker present).

After the stripping booth ventilation was tested, the wash booth was enclosed and ventilated. The existing 18-inch propeller fan mounted in the outside wall was connected to a 24-inch by 32-inch duct made of plywood which terminated in a
24-inch by 24-inch opening in the side wall of the wash booth. Vapors from inside the wash booth were exhausted to the outdoors, providing an indraft through the curtain opening in the front face of the booth. Face velocities on the wash booth ranged from 120-220 fpm with an average of 200 fpm (no worker present).

The bucket of recycled stripping solution was also vented. Exhaust from the surface of the five gallon bucket was provided by a semi-circular, ¾-inch slot mounted at the rear, top edge of the bucket. Exhaust of about 100 CFM through the slot was provided by a small, high pressure blower. This same blower, connected to pipes pierced by 1-inch diameter holes, installed below the drain pans of the two booth enclosures, also exhausts about 100 CFM each from these two areas. Each area below the pans encloses about 64 cubic feet. The 100 CFM provides over 90 air changes per hour to prevent buildup of flammable vapors at floor level. Since methylene chloride

vapors are heavier than air, it is important to provide ground-level exhaust ventilation under the booths to remove vapors of spilled stripping solvent.

IV. MATERIALS AND METHODS

Environmental air samples were collected on three separate occasions: October 7, 1992, November 20, 1992, and February 10, 1993. Personal breathing zone (PBZ) and area air monitoring was conducted for methylene chloride by collection on two 150-milligram (mg) charcoal tubes connected in series. Gilian model LFS-113D personal sampling pumps were used to collect the samples at 20 to 100 cubic centimeters per minute (cc/min). The samples were analyzed by gas chromatography (GC) equipped with a flame ionization detector (FID) according to NIOSH method #1005.[1] Air samples for methanol were collected on 150-mg silica gel tubes at 50 to 100 cc/min and analyzed according to NIOSH method #2000.[1]

V. EVALUATION 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 important, however, 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 preexisting 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 often are not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes and, thus, potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs), and 3) the U.S. Department of Labor/Occupational Safety and Health Administration (OSHA) occupational health standards [Permissible Exposure Limits (PELs)]. Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA standards. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that the company is required by the Occupational Safety and Health Administration to meet those levels specified in 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. A discussion of the two substances of interest for this survey is presented below.

A. Methylene Chloride

Methylene chloride, or dichloromethane, is a chlorinated organic compound that is commonly used as a solvent, paint remover, and degreaser. It may be absorbed into the body by inhalation of vapors and by absorption of liquid through the skin. If inhaled in high concentrations, methylene chloride may affect the nervous system, leading to symptoms such as mental

confusion, light-headedness, nausea, vomiting, and headache. Continued exposure to very high concentrations may cause increased light-headedness, staggering, unconsciousness, and death.[2] High vapor concentrations may also cause irritation of the eyes and respiratory tract. There have also been reports of chronic (long-term) neurotoxic (nervous system) effects among workers who have been exposed to methylene chloride for several years. Symptoms reported from chronic exposure have included forgetfulness, insomnia, headaches, fatigue, and hallucinations.[3] Exposure to methylene chloride may aggravate the symptoms of angina pectoris (heart pain), which may be accompanied by feelings of suffocation and palpitations. 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.[3] Rats and mice have developed tumors and cancers after exposure to methylene chloride under specific experimental conditions.[4] Therefore, NIOSH recommends that methylene chloride be regarded as a "potential occupational carcinogen", and that exposure be controlled to the lowest feasible level.[4] The current OSHA PEL is 500 ppm as an 8-hr TWA, however, OSHA has recently proposed limits of 25 ppm as a TWA and 125 ppm as a Short -Term Exposure Limit (STEL) under new rulemaking.[5] The current ACGIH TLV is 50 ppm as a TWA and a designation of A2, a suspected human carcinogen.[6]

B. Methanol

Methanol or methyl alcohol, is a common industrial solvent. It may be absorbed into the body by inhalation of vapors, by absorption of liquid through the skin, and by ingestion of the liquid. The most commonly reported symptoms of over-exposure to methanol vapors include headaches and blurred vision.[7] Other symptoms include conjunctivitis, giddiness, insomnia, gastric disturbances and vision failure. There are many cases of accidental ingestion of methanol, in the belief it was ethyl alcohol, which have resulted in temporary and permanent loss of eyesight and death. The current OSHA PEL, NIOSH REL, and the ACGIH TLV is 200 ppm as a TWA. In addition, both NIOSH and ACGIH recommend a STEL of 250 ppm.

VI. RESULTS

The results of the of air samples for MeCl and MeOH from the first survey are summarized in Table 1. The personal exposure levels for MeCl ranged from 83 ppm for a short-term sample collected during hand stripping with a gel to 523 ppm for a 100-minute sample collected while stripping a headboard. Area samples for MeCl ranged from 37 ppm on the workbench behind the wash booth to 246 ppm above the 5-gallon pail of recirculated stripping solvent. The MeOH levels ranged from 30 to
95 ppm.

Sample results for the second survey, collected after enclosure and ventilation of the stripping booth, are summarized in Table 2. No samples were collected for MeOH since the initial levels were low. Personal samples for MeCl ranged from 10 to
113 ppm. Area samples were also lower, ranging from 6 to 120 ppm. There was also less stripping activity during the second survey.

Table 3 presents a summary of air sample results from the third survey, collected after enclosures were added for both the stripping and wash booths and both areas were ventilated. Personal samples ranged from 19 to 110 ppm for MeCl and from 7.4 to
26 ppm for MeOH. Area samples for MeCl ranged from 2.1 to 18 ppm and from
2.7 to 9.1 ppm for MeOH.

Table 4 is a summary of the 8-hour TWA determinations for MeCl for all personal samples collected with a comparison over all three surveys. The TWA levels ranged from 177 to less than 1 ppm. The amount of time spent stripping varied considerably, ranging from 14 to 323 minutes.

Table 5 is a comparison of area samples collected for the different surveys. The MeCl levels varied considerably from 2.1 to 215 ppm. These data are also presented graphically in Figure 4.

VII. DISCUSSION

Exposure to MeCl has been a traditional problem in furniture stripping operations.[8] That was also true at the Ackerman shop prior to installation of the new ventilation controls. Individual exposure determinations dropped from highs of 400-523 ppm to 100 ppm or less. 8-hr. time-weighted averages dropped from highs of 177 ppm to less than 50 ppm. The TWA levels are highly influenced, not only by the presence of the ventilation system, but by the amount of time the workers spent stripping. Workers reported that they usually spent no more then 1-2 hours on any given day stripping furniture. Very rarely would longer periods be spent. Some of the stripping times reflected in the data presented here are artificially high because of the experimental nature of this project. That is, workers would save work to strip while the NIOSH investigator was in the shop so as to maximize the number and variety of samples collected in any given day.

Other factors which may have contributed to elevated MeCl levels include: (1) poor housekeeping (during the first two surveys), (2) limitations on design parameters to modify the existing strip/wash booths, (3) allowing furniture to dry in the open area of the stripping room (residual MeCl being vaporized), and (4) individual employee work practices. During the first two surveys, the practice was to store used stripper solvent and paint sludge (in open 5-gallon containers) adjacent to the stripping solvent drums in the stripping room. MeCl would continue to vaporize from these containers for some time. Levels of 246 ppm (first survey, see Table 1) and 215 ppm of MeCl were found in the area above these waste buckets during the second survey (Table 2). Waste rags and paper towels with stripping solvent on them were discarded in open 55-gallon drums, which also contributed to the MeCl air levels.

Area samples collected near furniture that was drying in the open area of the room, resulted in levels of 42-82 ppm MeCl (Tables 2 and 5). This represents another general area source of MeCl. During the initial survey (Table 1), very little or no room ventilation was left on except when stripping was occurring. MeCl levels would build-up in the room, and migrate out, during the day. MeCl levels measured at the entrance to the room averaged 166 ppm (Table 5), indicating a significant air level in the room from all the generation sources. This can also be a problem with a build-up overnight. Small amounts of MeCl were also generated from the waste water tanks under the wash booth, where 52 ppm of MeCl was found during the first survey (Table 1).

The best location for ventilation exhaust within the booths would be at the back of the booths so that solvent vapors would be pulled away from the workers. The location of the booths, the existing exhaust fan, and the access to the outside wall dictated that the exhaust takeoff be located on the end of the booths. This was primarily due to financial limitations. The greatest drawback for this exhaust location, was that solvent vapors would be pulled laterally across the booth and out the side. If a worker puts their head inside the booth (beyond the face), there was a greater chance they would be exposed to these exiting vapors. Workers were observed putting their whole upper torsos past the booth face, especially when working with large pieces, such as dresser drawers. One worker was instructed not to do this, and why, but he was found to be conducting work in the same manner during the next site visit three months later.

VIII. CONCLUSIONS

High levels of MeCl were found during the initial environmental survey. The 8-hr TWAs were above the 50 ppm TLV recommended by ACGIH but below the OSHA PEL of 500 ppm. Individual samples were as high as 523 ppm MeCl. The new ventilation system reduced worker exposure to MeCl. After ventilation was installed, the 8-hr. TWA exposures were all less than 50 ppm, which is less than the current OSHA PEL and the ACGIH TLV. NIOSH recommends that exposures to MeCl be reduced to the lowest feasible concentration. Further reductions in worker exposures can be realized with improved housekeeping of all MeCl sources (e.g., waste buckets, waste rags and towels, drying furniture, and open bulk containers of stripping solvent) and training of employees to improve their work practices.

IX. RECOMMENDATIONS

1. All open sources of methylene chloride should be removed from the room or placed in ventilated areas. This includes open buckets of waste stripper and paint sludge, wet rags and paper towels and newly stripped furniture. When buckets with used stripper and paint sludge are cleaned or removed, they should be either placed in one of the booths with the ventilation on or capped and removed to the outside. Newly stripped furniture should be allowed to dry as much as possible in the wash booth before being moved to the open floor.

2. Some ventilation should be kept on at all times during the day and, if possible, overnight. If it is not economically feasible to leave the ventilation on overnight, then the ventilation should be activated upon arrival in the morning, and the room should be allowed time to ventilate (15-30 minutes) prior to entry. Only one fan need be operated, preferably on the stripping booth.

3. Employees should be trained on proper work practices when stripping furniture. This includes proper use of all protective clothing (not all workers used all protective garments all the time), and, most importantly, to keep their head outside the plane of the booth as much as possible. Protective garment use should include an impervious apron and over-the-elbow gloves, face shield or goggles, boots, and long pants. The recommended materials for aprons and gloves are Viton/neoprene.

4. Hand stripping table tops and other large flat surfaces should be done in the booths when possible. If it cannot be done in a booth, the worker should try to stay on the upwind side of the surface, ie., do not get between the surface and the ventilation exhaust.

5. Quarterly testing of the face velocity of the two hoods is recommended.

X. REFERENCES

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XI. AUTHORSHIP AND ACKNOWLEDGMENTS

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Copies of this report have been sent to:

1. Owner, Ackerman & Sons
2. U.S. Department of Labor/OSHA - Region VIII
6. NIOSH, Region VIII

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

TABLE 1
SUMMARY OF PERSONAL AND AREA AIR CONCENTRATIONS OF METHYLENE CHLORIDE
AND METHANOL PRIOR TO INSTALLATION OF CONTROLS
Ackerman & Sons
Englewood, Colorado
HETA 92-0360
October 7-8, 1992

Description/Sample Location	Worker #	Duration (min)	MECL Conc(ppm)	MEOH Conc(ppm)
Personal, stripping large chest	1	78	414	73
Area, on door at entrance to room	1	102	166	ND
Personal, stripping headboard	1	101	523	95
Area, on door at entrance to room	1	78	167	30
Personal, strip wicker chairs	2	23	398	75
Area, edge of stripping booth above recycle can	2	59	246	NS
Area, above water reservoir between wash booth and outside wall	2	62	52	NS
Personal, hand strip table with Palco gel stripper	3	14	83	39
Area, on workbench south of wash booth	4	182	37	NS
Area, above drum of bulk stripper	4	60	120	NS
Personal, large dresser and drawers	5	58	445	62
Continuation of above	5	30	393	66
Personal, hand strip table with gel	5	16	174	NS
Area, above drum of bulk stripper	5	102	86	NS

ND = non detectable, 0.01 milligrams per sample
NS = not sampled
ppm = parts per million

TABLE 2
SUMMARY OF PERSONAL AND AREA AIR CONCENTRATIONS OF METHYLENE CHLORIDE
AFTER INSTALLATION OF CONTROLS: STRIPPING BOOTH
Ackerman & Sons
Englewood, Colorado
HETA 92-0360
November 20, 1992

Description/Sample Location	Worker #	Duration (min)	MECL Conc(ppm)
Area, center of room before ventilation system turned on	-	18	32
Personal, stripping 6 chairs	4	35	10
Area, above MeCl waste buckets	4	215	15
Area, on edge of wash booth, near worker breathing zone (BZ)	4	33	120
Area, above wash sludge tank	4	57	6.3
Area, above chairs that were newly stripped	4	82	85
Personal, stripping crib	1	33	95
Area, on edge of wash booth, near worker BZ	1	34	58
Area, on work bench behind wash booth	1	102	4.5
Area, S Central part of room, near newly stripped crib	1	42	25
Personal, strip large desk	1	103	110
Area, on edge of wash booth, near worker BZ	1	101	59
Area, near newly stripped desk drawers	1	59	32

ND = non detectable, 0.01 milligrams per sample
BZ = breathing zone
ppm = parts per million
NS = not sampled

TABLE 3
SUMMARY OF PERSONAL AND AREA AIR CONCENTRATIONS OF METHYLENE CHLORIDE
AND METHANOL AFTER INSTALLATION OF ALL CONTROLS
Ackerman & Sons
Englewood, Colorado
HETA 92-0360
February 10, 1993

Description/Sample Location	Worker #	Duration (min)	MECL Conc(ppm)	MEOH Conc(ppm)
Area, Center of Rm before	-	30	2.1	NS
Personal, stripping rocking chair	2	24	19	7.4
Area, above stripping drum	2	25	<4	3.9
Area, near entrance to room	2	102	5.4	NS
Personal, stripping 7 chairs	1	52	90	16
Area, above stripping drum	1	75	2.6	3.7
Area, near drying chairs,	1	113	11	NS
Personal, strip chairs	1	97	36	8.5
Area, above wash sludge tank	1	92	5	NS
Area, above stripping drum	1	87	5	2.7
Area, above door at entrance to Rm	1	84	4	NS
Personal, stripping large dresser	1	113	70	17
Area, above stripping drum	1	182	ND	5.6
Area, above door at entrance to Rm	1	178	8.4	9.1
Area, above dresser while drying	1	107	18	NS
Personal, stripping dresser drawers	1	61	110	26

ND = non detectable, 0.01 milligrams per sample
NS = not sampled
ppm = parts per million

TABLE 4
SUMMARY OF 8-HR TIME-WEIGHTED AVERAGE EXPOSURES TO METHYLENE CHLORIDE

Ackerman & Sons
Englewood, Colorado
HETA 92-0360

Worker #		Survey # (Date) 1 (10-7-92)	2 (11-20-92)	3 (2-10-93)
1	TWA (ppm)	177	31	48
	Time Stripping (hr)	3	2.3	5.4
	(min)	179	136	323
	High MCL Levels (ppm)	523	110	110
2	TWA (ppm)	19	NS	1.0
	Time Stripping (hr)	0.4		0.4
	(min)	23		24
	High MCL Levels (ppm)	398		19
3	TWA (ppm)	2.4	NS	NS
	Time Stripping (hr)	0.23		
	(min)	14		
	High MCL Levels (ppm)	83		
4	TWA (ppm)	LOST	0.7	NS
	Time Stripping (hr)		0.6	
	(min)		35	
	High MCL Levels (ppm)	10		
5	TWA (ppm)	85	NS	NS
	Time Stripping (hr)	1.7		
	(min)	104		
	High MCL Levels (ppm)	445		

ppm = Parts of Methylene Chloride (MCL) Per Million Parts of Air
TWA = Time-Weighted Average
High = Highest Average Methylene Chloride Concentration Measured
NS = Not Sampled
Survey #1 = No Controls in Place; #2 = Stripping Booth Only with Controls;
#3 = Full Controls in Place

TABLE 5
SUMMARY OF AREA SAMPLES FOR METHYLENE CHLORIDE FOR ALL VISITS
Ackerman & Sons
Englewood, Colorado
HETA 92-0360

Area	Survey # (Date) 1 (10-7-92)	2 (11-20-92)	3 (2-10-93)
Entrance to Room	166	18	5.5
	167	2.3	4.0
		8.4	
average	**166**	**10**	**5.9**
		Above MeCl drum	120
215	<4		
86		2.6	
			5
		ND	
average 103		**2.9**	
Center of Room, near Drying Furniture	-	82	2.1
	42	11	
	59	18	
average		**61**	**10**
Above Wash Water Tank	52	-	
5			
Work bench, Behind Wash Booth	37	102	5
Above MeCL Waste Buckets	246	215	NA
Edge of Wash Booth	-	33	-
	34		
	101		
average		**56**	

ppm = Parts of Methylene Chloride Per Million Parts of Air
ND = Not Detected at a limit of 0.01 milligrams per sample
Survey #1 = No Controls in Place; #2 = Stripping Booth Only with Controls;
#3 = Full Controls in Place