In-Depth Survey Report

Assisting Furniture Strippers in Reducing the Risk from Methylene Chloride Stripping Formulations at The Strip Joint, Inc. Redondo Beach, California

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SIC CODE	7641
SURVEY DATE	January 22, 1998 May 20-21, 1998
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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) conducted research on ventilation controls for reducing furniture stripping exposures to methylene chloride Low cost ventilation systems were designed by NIOSH researchers and built and installed by Benny Bixenman of Benco Sales, Inc (Crossville, TN) This report compares the methylene chloride levels of workers stripping furniture using different ventilation systems and different stripping solutions Two surveys were conducted During both surveys, two different chemical stripping solutions were used, the standard formulation (70-80% methylene chloride, B-7) and a low methylene chloride content formulation (50-60% methylene chloride, B-50)

The first survey tested three control combinations, 1) slothood ventilation, low methylene chloride stripper, 2) slothood ventilation, standard stripping solution, and 3) PVC pipe ventilation, standard stripping solution During each test, sorbent tube sampling and real-time sampling were employed Sorbent tube data collected in the worker's breathing zone ranged from 138 to 1052 ppm Data from both the sorbent tubes and real-time instruments showed that slothood ventilation with low methylene chloride stripper produced the lowest methylene chloride exposure levels

Slight modifications were made to the ventilation system before the second survey The slothood ventilation system was in use during testing Breathing zone exposures were not reduced to the OSHA methylene chloride PEL of 25 ppm Both stripping solutions were tested, results did not show a statistical difference between the solutions Sorbent tube data collected in the worker's breathing zone averaged 563 ppm Two workers stripped furniture at the same time at one stripping tank during this survey It is recommended that only one employee work at each tank at one time Recommendations are given to alter the slot hood ventilation system to reduce worker's exposures Other workers in the facility who are not stripping or rinsing the furniture had exposures that were at or below the OSHA PEL

INTRODUCTION

In January, 1997, the Occupational Safety and Health Administration reduced the methylene chloride standard from 500 ppm to 25 ppm over an eight-hour time-weighted average (TWA) As a follow-up from that reduction, researchers from the National Institute for Occupational Safety and Health (NIOSH) determined that a demonstration site was needed to determine how to reduce employee methylene chloride exposures to the new OSHA standard while furniture stripping

In January 1998, NIOSH researchers conducted a study of worker exposures at the The Strip Joint, Inc as part of work related to a NIOSH cooperative agreement with the Institute for Research and Technical Assistance (IRTA, Santa Monica, CA) NIOSH was one part of a team which was evaluating worker exposures, environmental levels of methylene chloride, and stripping solution usability at the facility Other parties present included IRTA, the South Coast Air Quality Management District (Diamond Bar, CA), Benco Sales, Inc (Crossville, TN), the California Air Resources Board (Sacramento, CA) and Southern California Edison (Rosemead, CA) In May 1998, a return visit was made to evaluate changes made to the newly installed local exhaust ventilation systems

PLANT AND PROCESS DESCRIPTION

The Strip Joint employed approximately five full-time men, plus a manager Two people stripped furniture full-time and approximately three others performed repairing and finishing work Paint, varnishes, and stains were stripped using a flow system The flow system consisted of an open tray in which items were stripped by pumping stripping solution through a brush in a flow pattern over the item while brushing stripped coatings from the furniture The stripping solution flowed to a drain in the tray and then into a pail where it was again pumped through the brush to flow over the item being stripped The employee then transported the furniture to a table in the rinse area where a high pressure water system was used to spray the solution from the furniture The water for the rinsing system was also collected and reused Oxalic acid solution was then lightly sprayed on most pieces of furniture to reduce lightening of the wood The furniture was then moved to an adjacent area to dry

HEALTH HAZARDS AND OCCUPATIONAL EXPOSURE CRITERIA

Potential chemical hazards in the furniture stripping industry are found primarily during the handling, stripping, and rinsing of the furniture Other exposure sources may include transferring of the stripping solution, the evaporation of solution from the tank, and the evaporation of the solution from the furniture The major routes of entry of methylene chloride and other solvents into the body include inhalation of vapors and absorption of the liquid through the skin The severity of the hazard depends on ventilation, general workstation design, work practices, duration of exposure, the formulation of the stripping solution, type of operation, and temperature

Health effects studies of methylene chloride exposure have focused on central nervous system, cardiovascular morbidity and mortality, cancer in exposed workers (NIOSH, 1977), and reproductive disorders (Kelley, 1988) Repeated skin contact with methylene chloride may cause dry, scaly, and cracked skin At high airborne concentrations (greater than 500 ppm), vapors are irritating to the eyes and upper respiratory tract Direct contact with the liquid can cause skin burns Methylene chloride is a mild narcotic Effects from intoxication include headache, giddiness, stupor, irritability, numbness, and tingling in the arms and legs The reports of odor threshold range from 25 to 350 ppm (NIOSH, 1977)

A death was reported resulting from using methylene chloride to strip furniture An 18-year old man was stripping furniture at a small facility in Chattanooga, Tennessee where it was assumed that he was overcome by vapors and collapsed into the stripping tank This facility had no local ventilation system to remove the methylene chloride vapors Also, the solution in the dip tank was at a low level causing the employee to put his face into the tank to scrub the furniture A local exhaust ventilation system for the dip tank in conjunction with maintaining a higher level of stripping solution in the tank were recommended to the facility owner to prevent another tragedy (Hall and Estill, 1999)

The current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for methylene chloride is an 8-hour time-weighted average (TWA) concentration of 25 parts per million (ppm), with a short-term exposure limit (STEL) concentration of 125 ppm for a 15 minute period This standard was adopted on January 10, 1997 The previous standard was a PEL of 500 ppm with an STEL of 1000 ppm

An action level of 12 5 ppm was also put into place by the new methylene chloride standard Once it has been determined that an employee has exposures over the action level, the employer must begin compliance activities including exposure monitoring (every six months) and medical surveillance (employees see a health care provider at the expense of the employer, if exposed more than 30 days per year) If exposures are also above the PEL, exposure monitoring is required every three months (OSHA, 1997)

NIOSH regards methylene chloride as a "potential occupational carcinogen" and recommends that methylene chloride be reduced to the lowest feasible limit (NIOSH, 1992) This recommendation was based on the observation of cancers and tumors in both rats and mice exposed to methylene chloride in air (NIOSH, 1986)

FACILITY BACKGROUND

Two stripping solutions were compared during both surveys The Benco #B7 stripping solution consisted of approximately 70 to 85% methylene chloride, 8 to 15% methanol, and less than 10% other ingredients according to the Material Safety Data Sheet (MSDS) effective May 8, 1997 The Benco #B50 stripping solution consisted of 50 to 60% methylene chloride, 10 to 20% branched acetate ester, 8 to 15% methanol and less than 10% other ingredients according to the MSDS effective December 12, 1996 The B50 stripping solution is composed of considerably less methylene chloride Comparing worker methylene chloride exposures using this reduced methylene chloride stripping product was one of the goals of this survey

The first survey compared a PVC pipe ventilation system (which the owner had installed many years before) to a newly installed slothood ventilation system The second survey evaluated alterations which were made to the slothood ventilation system The stripping tank consisted of a 5 by 10 foot tank, 37 inches high, with a depth sloped from 9 to 13 inches The smaller rinsing tank was 4 by 8 feet with a height of 37 inches

The PVC ventilation system was installed at the stripping tank only The system consisted of 6 inch PVC pipe wrapped around the right, left, and back sides of the tank There were seven holes which were each 2 inches in diameter cut through to the inner, upper sides of the stripping tank The system was connected by flexible duct to a small centrifugal fan which exhausted through the ceiling The entire system exhausted only 126 cfm See figures 1 and 2

Figure 1 PVC pipe ventilation system, arrows point to inlet holes

Figure 2 PVC pipe ventilation system, arrow points to flexible duct

A slothood ventilation system was designed by NIOSH researchers according to the ACGIH Ventilation Manual, plate VS-99-08 (ACGIH, 2001) Benco Sales took the design specifications and adapted them to this stripping facility and developed an inexpensive ventilation system The slothood ventilation system consisted of two hoods, one on the stripping tank and one on the rinsing tank A hood was attached to the back of the tank that was 9 feet, 8 inches long, 23 inches high, with a depth which ranged from 7-1/2 to 17 inches (Figures 3 and 4) There was a baffle around the tank and hood that enclosed the tank The baffle was 56 inches above the top edge of the tank On the left side of the tank the baffle extended 45 inches from the back of the tank On the back side of the tank, the baffle extended 34 inches above the hood On the right side of the tank the baffle extended 12 inches from the back The hood consisted of three slots that were 9 feet long by 1 inch wide The bottom slot was 1 inch above the lip of the tank, the second slot was 11-1/2 inches above the lip of the tank, and the top slot was 22 inches above the lip of the tank The hood was connected directly to a 12-1/2 inch diameter duct on the left side (the 17 inch deep side) of the hood The 12-1/2 inch duct was connected to a centrifugal blower (Dayton centrifugal blower Model 4C217, RPM 1725, HP 1, 12-1/2 inch diameter, cost $438 50) The blower was then connected to a 10 inch diameter duct which went directly through the ceiling to exhaust outside the building During the first survey, the stripping hood exhausted approximately 1400 cfm with an average slot velocity of 618 fpm (range of 420 to 860 fpm)

Figure 3 Slothood ventilation system for strip tank, notice abrupt transition from the plenum to the fan (left side)

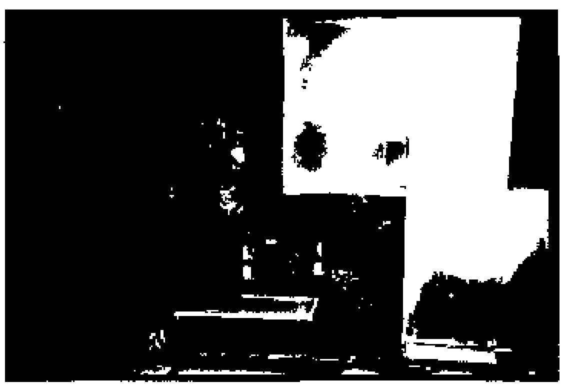

Figure 4 Slothood ventilation system for strip tank, side view

For both surveys, a slothood ventilation system for the rinsing hood was used much like the stripping hood A hood was attached to the back of the tank that was 7 feet long, 23 inches high, with a depth which ranged from 7-1/2 to 17 inches (Figure 5) Unlike the stripping ventilation, there were no other baffles but the tank was surrounded on three sides by walls The hood consisted of three slots that were 7 feet long by 1 inch wide The bottom slot was 1 inch above the lip of the tank, the second slot was 11-1/2 inches above the lip of the tank, and the top slot was 22 inches above the lip of the tank The hood was connected directly to a 12-1/2 inch diameter duct on the right side (the 17 inch deep side) The 12-1/2 inch duct was connected to a centrifugal blower (Dayton centrifugal blower Model 4C217) The blower was then connected to a 10 inch diameter duct which went directly through the ceiling to exhaust outside the building The rinsing hood exhausted approximately 1900 cfm with an average slot velocity of 1105 fpm (range of 800 to 1550 fpm)

Figure 5. Slothood ventilation system for rinse tank

For the second survey, the hood was altered by Benco Sales The width of the slots for the stripping area were reduced from one to ½ inch Also, the slothood was moved over the stripping tank so that the distance from the front edge of the tank to the slothood was only four feet instead of five feet This change also moved the side baffles closer to the front by one foot This change also left a gap below the slothood rather than a smooth baffle After the changes to the stripping tank ventilation system, the exhaust volume was increased to 1870 cfm with an average slot velocity of 1560 fpm Slot velocity became very uneven between the right and left sides of the tank The slot velocity on the right side of the tank averaged 1322 fpm (standard deviation 358 fpm), while the left side of the tank was 1805 fpm (s d 159 fpm) For 12 measurements on each side, the left and right flow rates were statistically different using a two sided t-test ($p=0.0003$)

For the second survey, the only change to the rinse tank was that the slots were reduced to ½ inch The rinse tank hood exhausted about 1830 cfm with an average slot velocity of 1550 fpm (range 1040 to 1900 fpm) A t-test comparison of slot velocities of the left to right sides of the tank found no differences ($p=0.23$)

METHODS

During the first survey, air sampling measurements were taken on two employees during stripping and rinsing operations These employees alternated between stripping and rinsing Two stripping solutions (Benco #B7 and #B50) and two ventilation systems (PVC system and slothood system) were used There were three sampling periods During the first sampling period, Benco B50 stripper was used with the slothood ventilation system for three hours The second sampling period consisted of Benco B7 stripper with the slothood ventilation system for one hour and seven minutes The third sampling period consisted of Benco B7 stripper with the

PVC ventilation system for one hour and fifteen minutes During each of the sampling periods, charcoal sorbent tube samples were taken on two employees in their breathing zone One employee worked at the stripping tank while the other employee worked at the rinsing tank Stripping and rinsing were two distinct jobs Both workers were capable of performing either job After an hour or two the workers would trade jobs In addition to the breathing zone samples, area sorbent samples were taken in the stripping area (located approximately 46 inches from the right front corner of the stripping tank at a height of 80 inches), the rinsing area (located approximately 24 inches from the left front corner of the tank at a height of 74 inches), and the drying area (located approximately 36 inches from the front edge of the drying area at a height of 35 inches) Air samples for methylene chloride were collected on two 50/100 mg charcoal tubes (SKC 226-01, SKC, Inc , Eighty-Four, PA) in series Sampling was conducted at a nominal flow rate of 0 02 liters per minute (LPM) using a personal sampling pump (Gilian LFS113, Gilian Instrument Corporation, West Caldwell, NJ) Samples were sent to DataChem Laboratory (Salt City, UT) for analysis using NIOSH method 1005 from the NIOSH Manual of Analytical Methods (NIOSH, 1994)

During the first survey, real time sampling was performed on both employees A MiniRAE (RAE Systems, Sunnyvale, CA) hand-held photoionization detector for VOC measurement with a 11 7 eV lamp was used to detect solvent vapors in the air Real time sampling was performed for at least one hour during each of the three sampling periods All photoionization detector measurements were referenced to the span gas of isobutylene at 100 ppm

During the second survey, there were three sampling periods using the improved slothood ventilation system for the stripping and rinsing tanks During the first and third sampling period, Benco B7 stripper was used while Benco B50 stripper was used during the second sampling period The first sampling period consisted of two runs of 66 minutes and 33 minutes The second sampling period consisted of four runs lasting 65, 77, 41, and 70 minutes The third sampling period consisted of one run lasting 55 minutes During the sampling periods, charcoal sorbent tube samples and ORBO 91 sorbent tube samples were taken side by side in the breathing zone of two employees The ORBO tube samples were analyzed by gas chromatography using OSHA Method 80 with modifications for the desorption process, column, and oven conditions One employee worked on the right side of the stripping tank while the other employee alternated between the rinsing tank and the left side of the stripping tank One employee had the responsibility of rinsing all the furniture, but as time allowed he would also strip furniture Often both employees were stripping furniture at the same time

In addition to the breathing zone samples, area sorbent samples were taken in the stripping area at the same locations as during the first survey The one exception was the addition of a second sample near the stripping tank (located approximately five feet from the left front corner at a height of four feet).

RESULTS

Table 1 shows sorbent tube sample results for the first survey The samples that were supposed to be blank had methylene chloride on them (up to 2 ppm) The quality control samples submitted with these samples were on average in control but one was as high as 27% different than the expected value In the table, results are divided by stripper type and ventilation system but not by individual worker For each worker, a time weighted average (TWA) based on the time of stripping was computed For one worker the TWA was 505 ppm while stripping and rinsing for 5 hours and 16 minutes For the second worker the TWA was 482 ppm while stripping and rinsing for 5 hours and 10 minutes

Real-time sampling also compared the three sampling periods during the first survey A period was analyzed during each of the three sampling periods for stripping For rinsing, only two conditions were collected and analyzed Table 2 shows the results from the real-time monitoring Figure 6 uses these real time data of stripping, rinsing, and transporting to compare relative concentrations with the amount of time spent on the task

Bulk samples were taken of the stripping and rinsing solutions used during the first survey to determine percent methylene chloride content The B50 stripper was found to have 40% methylene chloride, the B7 stripper was found to have 75% methylene chloride and the rinse water was found to have a non-detectable amount of methylene chloride

During the first survey, breathing zone concentration results for the two stripping solutions were compared while using the new ventilation system For the B50 stripping solution, there were six samples and there were two samples for the B7 The log of each result was taken These log results were compared using a two-sample t-test assuming unequal variances There were no statistically significant difference between the stripping solutions

Table 3 shows the sampling results from the second survey In the table, results are divided by stripper type but not by individual worker For each worker, a time weighted average (TWA) based on the time of stripping was computed using the charcoal samples For one worker, the TWA was 721 ppm while stripping and rinsing for 1 hour and 33 minutes on the first day and 530 ppm while stripping and rinsing for 5 hours and 23 minutes on the second day For the second worker, the TWA was 102 ppm while stripping and rinsing for 1 hour and 42 minutes on the first day and 693 ppm while stripping and rinsing for 5 hours and 21 minutes on the second day ORBO results were slightly lower but similar

Table 1 First Survey Sampling Results - Charcoal Tubes

Solution and Ventilation System	Location* - Task	Time (min)	Methylene Chloride (ppm)	Methylene Chloride Time Weighted Average (ppm)
B50 Slothood	BZ - stripping and rinsing	181 178	216 629	420 ppm (stripping and rinsing)
	BZ† - stripping only	62 114	393 178	
	BZ† - rinsing only	65 114	164 138	
	Area - stripping	185	63	38 ppm
	Area - rinsing	186	40	
	Area - drying	187	11	
B7 Slothood	BZ - stripping only	64	718	496 ppm
	BZ - rinsing only	61	263	
	Area - stripping	62	56	51 ppm
	Area - rinsing	58	37	
	Area - drying	58	60	
B7 PVC	BZ - stripping only	71	1052	680 ppm
	BZ - rinsing only	71	308	
	Area - stripping	75	70	53 ppm
	Area - rinsing	74	44	
	Area - drying	74	45	

* BZ - Employee's breathing zone sample
† These samples were taken side by side with the "BZ-stripping and rinsing" samples of the same sampling period When the workers traded jobs, fresh samples were administered to denote the specific task

Table 2 Real-time results for employee's breathing zone - First Survey			
Sampling Period	Location	Time (min)	Average breathing zone exposure (ppm)
B50 stripper, slothood Vent	Stripping only	20	74
B7 stripper, slothood Vent	Stripping only	20	189
B7 stripper, PVC Vent	Stripping only	20	235
B50 stripper, slothood Vent	Rinsing only	13	37
B7 stripper, slothood Vent	Rinsing only	†	†
B7 stripper, PVC Vent	Rinsing only	10	108

† Data not collected for this combination

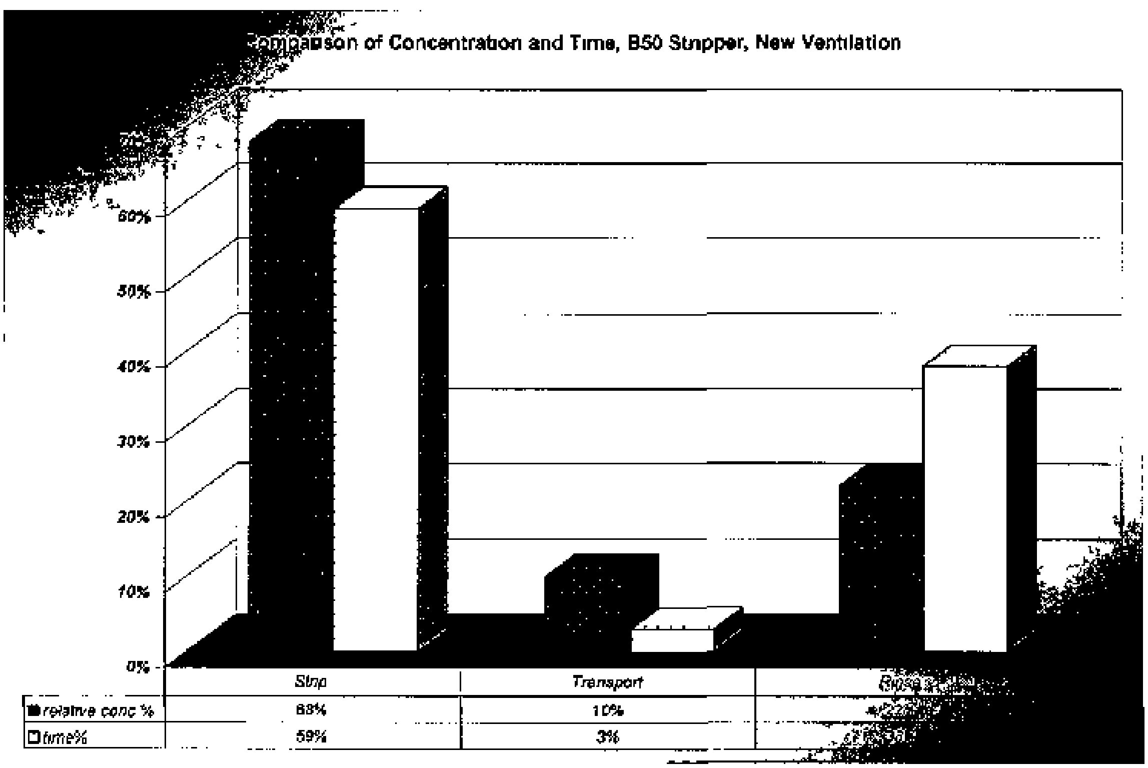

Figure 6 Real-time data task breakdown during the first survey

Table 3 Second Survey Sampling Results							
Stripper*	Location† - Task	No of Samples	Time (min)	Methylene Chloride Time Weighted Average (ppm)			
				Charcoal	ORBO	Charcoal	ORBO
	BZ - stripping and rinsing	3	192	345	260		
	BZ - stripping only	4	272	960	789	621	512
	BZ - rinsing only	1	65	13	97		
B50	Area - stripping 1 (right side)	4	254	15	16		
	Area - stripping 2 (left side)	4	257	58	35	25	19
	Area - rinsing	4	251	20	20		
	Area - drying	4	260	5	5		
	BZ - stripping and rinsing	1	60	370	323		
	BZ - stripping only	3	154	745	677	466	425
	BZ - rinsing only	2	102	102	58		
B7	Area - stripping 1 (right side)	3	157	14	14		
	Area - stripping 2 (left side)	3	169	21	10	13	10
	Area - rinsing	3	176	18	18		
	Area - drying	3	184	1	1		

*Ventilation system was the same for all cases during the second survey

† BZ - Employee's breathing zone sample

For the second survey, data from which ORBO and charcoal samples were taken side by side were compared A paired t-test was performed Charcoal samples were found to be statistically higher than ORBO samples (p=0 0122)

For the second survey, the charcoal area samples were compared to the OSHA PEL and Action Limit to determine if other workers within the facility would be within those limits Twenty-one rinsing and stripping area samples were compared to the OSHA PEL The geometric mean was 16 ppm with a geometric standard deviation of 2 ppm A t-test was used to compare this mean to both 25 and 12 5 The geometric mean was found to be statistically less than the PEL of 25 ppm (p=0 0079) and not found to be statistically less than the action limit of 12 5 ppm (p=0 0878)

For each of the solution types, these rinsing and stripping samples were compared to the PEL and the action limit The geometric mean for the B-7 stripper was 12 ppm with a geometric standard deviation of 2 ppm Using a t-test, the rinsing and stripping area concentrations for the B-7 stripping solution were found to be statistically less than the PEL (p=0 0068) but not statistically different from the action limit (p=0 9782) The geometric mean for the B-50 stripper was 20 ppm with a geometric standard deviation of 2 ppm The geometric mean was not found to be different from the PEL (p= 2742) and was found to be statistically greater than the action limit (p=0 0374)

Seven drying area samples were also compared to the PEL and action limits using a t-test The geometric mean was found to be 1 ppm with a geometric standard deviation of 4 ppm The geometric mean was found to be less than both the PEL (p=0 0009) and the action limit (p=0 0035)

For the second survey, breathing zone samples for the two stripping solutions were compared Logorithms were taken for each result The B50 solution had eight samples while the B7 solution had six samples A two-sample t-test assuming unequal variances was used to determine that there were no statistically significant differences between the two stripping solutions

DISCUSSION

Stripping Ventilation System

The ventilation system installed at the stripping tank was an improvement over the original PVC pipe ventilation system With the exhaust volume increasing from 126 to 1400 cfm, a decrease in exposure would be expected During the first survey and using the B7 stripping solution, breathing zone exposures were reduced from an average of 680 to 496 ppm With only one sample taken for each worker, it is not possible to determine if the reduction is statistically significant

During the first survey, the slothood did not perform to its design specifications due to the following

- The slothood was originally designed for an 8 by 4 foot tank rather than a 10 by 5 foot tank In general, local exhaust systems need to be as close as possible to the worker Tanks over 4 feet wide should have local exhaust ventilation on both the front and back sides of the tank After the first survey, the recommendation was to move the hood closer to the front of the tank by one foot Typically, furniture is not greater than 4 feet wide, since the rinsing tank is only 4 feet wide

- The additional two feet in length was not in the original design criteria After the first survey, it was recommended that the end to the far left (at least the first two feet) should not be used and the slots should be covered to increase overall slot velocity

- At one inch, the slots during the first survey were too wide It was recommended to reduce the width of the slots The original design called for ½ inch to ⅝ inch slots Smaller slot sizes would increase the velocity of the air through the slots The design criteria is a slot velocity of 2000 fpm (Open Surface Tanks, ACGIH, 2001)

- The duct came into the ventilation hood from the side with no gradual transition There would be less air turbulence in the system if there is a more gradual transition between the hood and the duct Therefore a 60° (from horizontal) angle between the duct and the plenum was recommended

For the second survey, the stripping tank consisted of the following

- The stripping tank ventilation hood was moved up by one foot to be only four feet from the worker The underneath of the ventilation hood was left open, a baffle should have been placed there

- The far left of the slots were not closed off The ventilation system and fan that had been designed for 8 foot long slots, were being used for 9 feet, 8 inch slots

- Slot width was reduced from one to ½ inch as directed This change increased average slot velocity from 618 fpm to 1560 Slot velocity still did not reach the ideal 2000 fpm

- The transition between the tank, the duct, and the fan was not changed An abrupt transition such as this would typically result in extreme pressure loss and turbulance within the system, especially in the plenum

The resulting stripping ventilation system is a local exhaust system which exhausted at a significantly higher rate on the left side (1805 fpm) compared with the right side (1322 fpm) Therefore, it would be expected that any worker working on the left side of the stripping tank would have lower breathing zone exposures than one working on the right side

The builder of this ventilation system for both surveys had a background in engineering, but no ventilation experience Although the authors designed a ventilation system that should have achieved desired volume and velocity, the builder did not realize the importance of following the designs exactly The furniture stripping industry is generally comprised of small business owners who do not have any engineering background and therefore are not likely to be able to design and build a system to meet the specifications without hiring professional help

Rinse Ventilation System
For the rinsing tank during the first survey the slots were one inch wide The original design called for ½ to ⅝ inch slots Smaller slot sizes increased the velocity of the air through the slots from 1105 fpm to 2171 fpm

Breathing Zone Samples
Breathing zone sample results from the first survey averaged 420 ppm for the best case scenario (slothood ventilation and low methylene chloride stripper) This high concentration made it apparent that the ventilation system was not coming close to the desired levels Again during the second survey, average breathing zone samples were above 400 ppm and not close to the desired levels

Area Samples
Area samples during the first survey were not reduced to the OSHA PEL of 25 ppm Area sample time weighted averages while using the B50 stripper were 38 ppm, while using the B7 stripper were 51 ppm for the slothood ventilation and 53 ppm for the PVC ventilation Time weighted averages were improved during the second survey to 25 ppm using the B50 stripper and 13 ppm using the B7 stripper

For the second survey, area rinsing and stripping samples were compared to the PEL and Action Level The B-7 stripping solution area sampling results were below the PEL and the B-50 area results were not statistically different than the PEL This result showed that other workers in the area (not the workers doing the stripping or rinsing) would likely have levels at or below the OSHA PEL but not below the OSHA Action Level Area samples from the drying area were statistically less than both the PEL and the Action Level This result shows that other workers in the facility who work near the drying area would not require the methylene chloride monitoring activities required for workers whose exposures are above the action limit

Work Practices
Work tasks and work practices can significantly affect exposures of methylene chloride among furniture strippers During the first survey, one worker worked at each of the stripping and rinsing tables Although the workers sometimes traded tasks, they did not perform the same task at the same time Real-time data (Figure 6) showed that carrying the furniture between tasks resulted in a larger percentage of exposures with respect to the time required to perform the task Transporting the furniture is an uncontrolled task that would be difficult to control with local exhaust ventilation Therefore, arranging the

shop to put the stripping and rinsing booths closer together would reduce exposures during transport Also shown in Figure 6 is the relative concentrations for stripping and rinsing compared to time The stripping task has a higher relative concentration Therefore, further work on ventilation controls should be targeted to the stripping area before the rinsing area

During the second survey, work practices were quite different from the first survey Two workers often worked at the stripping tank at the same time The worker assigned to the stripping booth often worked on the right side where the drain was located The second worker's primary job was to perform the rinsing operation, but when caught up, he would strip another piece of furniture at the stripping tank Two workers at the stripping tank cause twice as much methylene chloride to be aerosolized with the same amount of ventilation to control Workers were exposed not only to the methylene chloride that they aerosolized, but also what their co-worker aerosolized The worker who only did stripping stood on the right side of the tank which was shown to have a lower slot velocity then the left

Stripping Solution
For the first survey, the sorbent tube samples and the real-time data showed lower concentrations while using the B50 stripper B7 exposures were slightly lower during the second survey Neither survey was able to show a statistically significant difference between the two stripping solutions

Recommendations
For the stripping tank the following changes could be made to reduce exposures

- Only permit one worker to strip at the stripping tank at one time
- Place a baffle underneath the slot hood so that the slot hood is exhausting the air in front of the tank and not from underneath it
- Close off the slots on the left side of the tank About two feet should be closed off to increase slot velocities
- Change the transition between the slot plenum and the fan The transition should allow for a gradual reduction in cross-sectional area This gradual transition will reduce turbulance within the plenum thereby making the slots on the left and right sides of the tank more evenly distributed

CONCLUSIONS

The goal of reducing methylene chloride exposures while stripping furniture to the OSHA standard of 25 ppm was not achieved The new ventilation system did reduce exposures but differences were not statistically significant Other workers in the facility who are not conducting the stripping or rinsing tasks will have exposures that are at or below the OSHA PEL There was not a statistical difference between the two stripping solutions Those workers who are as far away as the drying area will likely have exposures below the action limit During the second survey, two workers often stripped furniture at the stripping tank thereby aerosolizing twice the methylene chloride with the same amount of ventilation It is recommended that only one employee work at each tank at one time

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DATE November 9, 2004

TO Marsha J Gran

FROM Engineering and Physical Hazards Branch, DART

RE Report No EPHB 170-23a

The following are keywords for inclusion in DIDS

Company Name The Strip Joint, Inc

SIC Code 7641

Processes and/or Equipment Studied furniture stripping, refinishing, paint stripping, stripping tank, rinsing tank

Materials Sampled For methylene chloride, methanol

Additional Keywords ventilation, local exhaust ventilation, LEV, task analysis, air samples, stripping solutions, alternative strip solution