IN-DEPTH SURVEY REPORT

ASSISTING FURNITURE STRIPPERS IN REDUCING THE RISK FROM METHYLENE CHLORIDE STRIPPING FORMULATIONS

at

Los Angeles Stripping and Refinishing Center
Los Angeles, California

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PLANT SURVEYED	Los Angeles Stripping and Refinishing Center 2337 San Fernando Road Los Angeles, California 90065
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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) is currently conducting research on ventilation controls to reduce furniture stripping exposures to methylene chloride to the OSHA PEL of 25 ppm Low cost ventilation systems were designed by NIOSH researchers along with Benny Bixenman of Benco Sales, Inc (Forney, TX) The controls were constructed and installed by Benco Sales This report compares the methylene chloride levels of one worker stripping furniture using the recently installed ventilation controls and using the existing controls During the survey, two different chemical stripping solutions (a standard formulation and a low methylene chloride content formulation) were used and compared This survey tested three control combinations, (1) new ventilation, low methylene chloride stripper, (2) new ventilation, standard stripping solution, and (3) old 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 300 to 387 ppm Real-time data showed breathing zone exposures to range from 211 to 383 ppm while stripping and 164 to 230 ppm while rinsing Data were inconclusive to determine which ventilation system or stripping solution produced the lowest exposures Recommendations are made in the report to improve the newly installed ventilation controls

INTRODUCTION

In January 1998, researchers from the National Institute for Occupational Safety and Health (NIOSH) conducted a study of worker exposures at the Los Angeles Stripping and Refinishing Center as part of work related to a NIOSH cooperative agreement with the Institute for Research and Technical Assistance (IRTA) (Santa Monica, CA) NIOSH 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 (Forney, TX), the California Air Resources Board (Sacramento, CA) and Southern California Edison (Rosemead, CA)

Background

On January 10, 1997, the Occupational Safety and Health Administration (OSHA) issued a standard regulating occupational exposure to Methylene Chloride The standard was designed to reduce the risk that methylene chloride exposure will cause cancer or other adverse health effects The standard reduced the prior 8-hours time-weighted average (TWA) Permissible Exposure Limit (PEL) from 500 parts per million (ppm) to 25 ppm It also set a short term exposure limit (STEL) of 125 ppm On September 22, 1998, OSHA amended the 1997 standard by moving the start-up date for which the standard will become effective for certain industries, including furniture stripping Furniture strippers with fewer than 20 employees will be required to use engineering controls or respirators to achieve the 8-hour TWA by April 10, 2000 Furniture strippers must already be using respirators if they are above the STEL of 125 ppm

Worker sampling measurements were taken on one co-owner during stripping and rinsing operations During that time, two stripping solutions (Benco #B7 and Benco #B50) and two ventilation systems (existing system and new system) were used

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

Ventilation Systems The new ventilation system consisted of two hoods, one on the stripping tank and one on the rinsing tank The stripping tank consisted of a 5 by 10 foot tank that was 37 inches high The depth of the tank sloped from 5 to 9½ inches (the bottom of the tank is well above the floor) A hood was attached to the back of the tank that was 92 inches long, 23 inches high, and the depth ranged from 7½ inches at the right end to 17 inches at the left end The hood was located on the left side of the tank because the hood was shorter than the tank, leaving the right side of the tank without ventilation The hood consisted of three slots that were 7 feet long by 1 inch wide The bottom slot was directly above the lip of the tank, the second slot was 10½

inches above the lip of the tank, and the top slot was 21 inches above the lip of the tank The stripping tank was located next to a wall on the longer (10 foot) side The hood was connected directly to 12½ inch diameter duct on the left side (the 17 inch deep side) The 12½ inch duct was connected to a centrifugal blower (Dayton centrifugal blower Model 5K459C, RPM 1725, HP ¾) The blower was then connected to a 10 inch diameter duct which went through two 90° turns then directly up through the ceiling to exhaust outside the building The stripping hood exhausted approximately 1155 cfm with an average slot velocity of 660 fpm (range of 430 to 920 fpm)

The rinsing hood was built much like the stripping hood The rinsing hood consisted of a 4 by 8 foot tank that was 35 inches high The depth of the tank sloped from 9 to 15 inches A local exhaust ventilation hood was attached to the back of the tank that was 7 feet long, 23 inches high, and depth ranged from 7½ to 17 inches 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 11½ inches above the lip of the tank, and the top slot was 22 inches above the lip of the tank The rinsing tank was located next to a wall on the longer (8 foot) side The hood was connected directly to a 12½ inch diameter duct on the left side (the 17 inch deep side) The 12½ inch duct was connected to a centrifugal blower (Dayton centrifugal blower Model 5K459C, RPM 1725, HP ¾) The blower was then connected to a 10-inch diameter duct which went through two 90° turns and then directly through the ceiling to exhaust outside the building The rinsing hood exhausted approximately 945 cfm with an average slot velocity of 540 fpm (range of 360 to 750 fpm)

The old ventilation system consisted of ventilation on the stripping tank only The system consisted of a suspended metal plate in the bottom of the stripping tank which was about ½ inch to 1½ inch short of all sides Therefore, exhaust slots were located in the bottom of the tank around the perimeter Under the metal plate was a 4-inch exhaust duct and some reservoirs to collect the stripping solution and paint chips The 4-inch duct was made of PVC pipe The ducting had seven 90° turns before and after the fan The entire system exhausted 233 cfm and slot velocities ranged from 80 to 125 fpm

Methods

There were three sampling periods (1) During the first sampling period, Benco B50 stripper was used with the new ventilation system during the time period 9 06 am to 11 50 am (2) The second sampling period consisted of Benco B7 stripper with the new ventilation system from 1 01 pm to 2 21 pm (3) The third sampling period consisted of Benco B7 stripper with the old ventilation system from 2 32 pm to 3 59 pm During each of the sampling periods, sorbent tube samples were taken on one worker in his breathing zone One worker performed both stripping and rinsing In addition, to the breathing zone samples, sorbent samples were taken in the stripping area (stripping sample 1 was located 7 4 feet from the right front corner of the stripping tank at a height of 72 inches, stripping sample 2 was located 5 1 feet from the left front corner of the stripping tank as a height of 73 inches), the rinsing area (located approximately 7 7 feet from the left front corner of the rinsing tank at a height of 74 inches), and the drying area (located approximately 5 1 feet from the right front corner of the rinsing tank at a height of 44 inches)

Real-time sampling was performed on the worker In the worker's breathing zone, a MiniRae analyzer with a 11 7 eV lamp was used to detect solvent vapors in the air The analyzer was calibrated using a span gas of 100 ppm isobutylene Real time sampling was performed for at least one hour during each of the three sampling periods

Results

See Table 1 for the results from the sorbent tube samples Results differed greatly for the breathing zone samples during sampling period number one The worker wore two pumps and the results for that 165 minute period were 136 ppm for one pump and 639 ppm for the second The two results were averaged to 387 ppm, the average was then used for other analyses A time-weighed average (TWA) for the 5 hours and 30 minutes that the worker was stripping and rinsing was 348 ppm An eight-hour TWA was computed assuming the worker had not other methylene chloride exposures, that result was 240 ppm

TABLE 1 SORBENT TUBE SAMPLES

Sampling Period	Location* - Task	Time (min)	Methylene Chloride (ppm)	Methylene Chloride Time Weighted Average (ppm)
B50 stripper New Vent	BZ - stripping and rinsing	165 165	136 639	387 ppm (stripping and rinsing)
	Area - stripping	162 161	143 112	135 ppm
	Area - rinsing	161	133	
	Area - drying	161	152	
B7 stripper New Vent	BZ - stripping and rinsing	81	300	300 ppm
	Area - stripping	77 76	127 174	137 ppm
	Area - rinsing	77	92	
	Area - drying	78	157	

Sampling Period	Location* - Task	Time (min)	Methylene Chloride (ppm)	Methylene Chloride Time Weighted Average (ppm)
B7 stripper Old Vent	BZ - stripping and rinsing	85	319	319 ppm
	Area - stripping	86	163	136 ppm
		85	194	
	Area - rinsing	87	90	
	Area - drying	87	97	
BZ Time-Weighed Average while stripping and rinsing		331		348 ppm
BZ **Eight-Hour** Time-Weighed Average		480		240 ppm

* BZ - Worker's Breathing Zone

Real-time sampling also compared the three sampling periods A period of continuous stripping was analyzed during each of the three sampling periods Stripping and rinsing were included in the real-time sampling results shown here, no carrying or pouring of solutions were included Table 2 shows the results from the real-time monitoring Figure 1 shows the real-time output while the worker was using the new stripping solution (B50) and the new ventilation controls As noted at the bottom of Figure 1, stripping was performed from 12 12 pm to 12 18 pm, transporting the furniture was performed from 12 18 pm to 12 19 pm, and rinsing was performed from 12 19 pm to 12 21 pm (EST, or 9 12 am to 9 21 am PST) Figure 2 uses the same information to compare relative concentrations with the amount of time spent doing the task

TABLE 2 REAL-TIME RESULTS FOR WORKER'S BREATHING ZONE

Sampling Period	Location	Time (min)	Average breathing zone exposure (ppm)
B50 stripper, New Vent	Stripping only	9	294
B7 stripper, New Vent	Stripping only	14	211*
		6	315*
B7 stripper, Old Vent	Stripping only	7	383
B50 stripper, New Vent	Rinsing only	17	182
B7 stripper, New Vent	Rinsing only	10	230
B7 stripper, Old Vent	Rinsing only	11	164

* Two periods were analyzed because the first period appeared to be consistently rising

Bulk samples were taken of the stripping and rinsing solution used during the survey to determine percent methylene chloride content The B50 stripper had 55 percent methylene chloride, the B7 stripper had 70 percent methylene chloride and the rinse water had 0 05 ppm of methylene chloride

Discussion

The sorbent tube samples and the real-time data were not able to show that the new B50 stripper and the new controls lowered worker's exposures to methylene chloride No exposures were as low as expected It is believed that the exposures were not reduced to the new methylene chloride standard of 25 ppm because of design flaws in the new ventilation system

It has been proposed to Benco Sales that some design changes be made for the new ventilation hoods The width of the slots need to be reduced They were one inch wide during this survey The design called for ½ inch to ⅝ inch slots Smaller slot sizes would increase the velocity of the air through the slots from 660 fpm (stripping tank) and 540 fpm (rinsing tank) to 1320 fpm (stripping) and 1080 fpm (rinsing) The design criteria is a slot velocity of 2000 fpm So additional changes such as increasing the fan volume and replacing the 90° angles with 45° angles for the ducting would help to increase the local exhaust ventilation volume

The hoods were originally designed for a 8 by 4 foot tank rather than a 10 by 5 foot tank as used for the stripping hood The local exhaust system needs to be as close as possible to the source of the exposure Tanks over 4 feet wide should have controls on both the front and the back of the tank Therefore, the recommendation is to move the hood closer to the front of the tank by one foot or install a hood with local exhaust ventilation on the front and the back

The additional two feet in length of the tank was not in the original design criteria For both rinsing and stripping tanks, the hoods were located to the left side while the worker tended to stand on the far right end of the tank where the hood was not located Besides moving the hoods closer by one foot, the hoods should be moved to the right side where the worker stands

During this survey, the duct connected to the ventilation hood from the side with no gradual transition There will 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 is recommended

There were some problems with the sample results for the sorbent tube samples The samples that were supposed to be blank had methylene chloride on them (up to 2 ppm) As shown in the results, two samples that were taken side by side differed greatly The quality control samples submitted with these samples were on average in control but one was as high as 27 percent different than the expected value The average value on the blanks was subtracted from each sample

CONCLUSIONS

The goal of reducing methylene chloride exposures to the new OSHA standard of 25 ppm was not achieved Additional work will be done at other furniture stripping facilities to improve the local ventilation systems

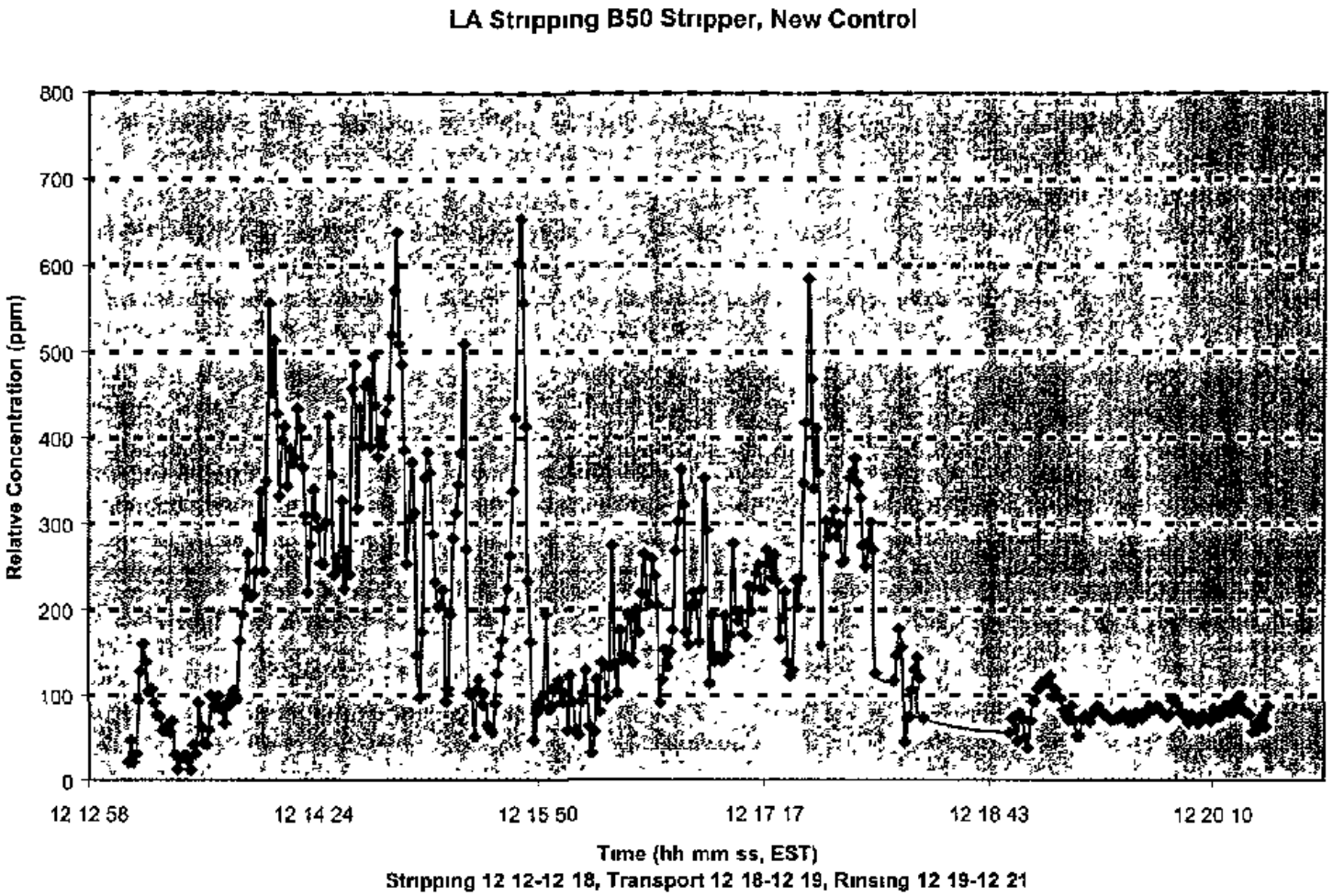
LA Stripping B50 Stripper, New Control
800
700
600
500
400
300
200
100
0
Relative Concentration (ppm)
12 12 58
12 14 24
12 15 50
12 17 17
12 18 43
12 20 10
Time (hh mm ss, EST)
Stripping 12 12-12 18, Transport 12 18-12 19, Rinsing 12 19-12 21

Figure 1

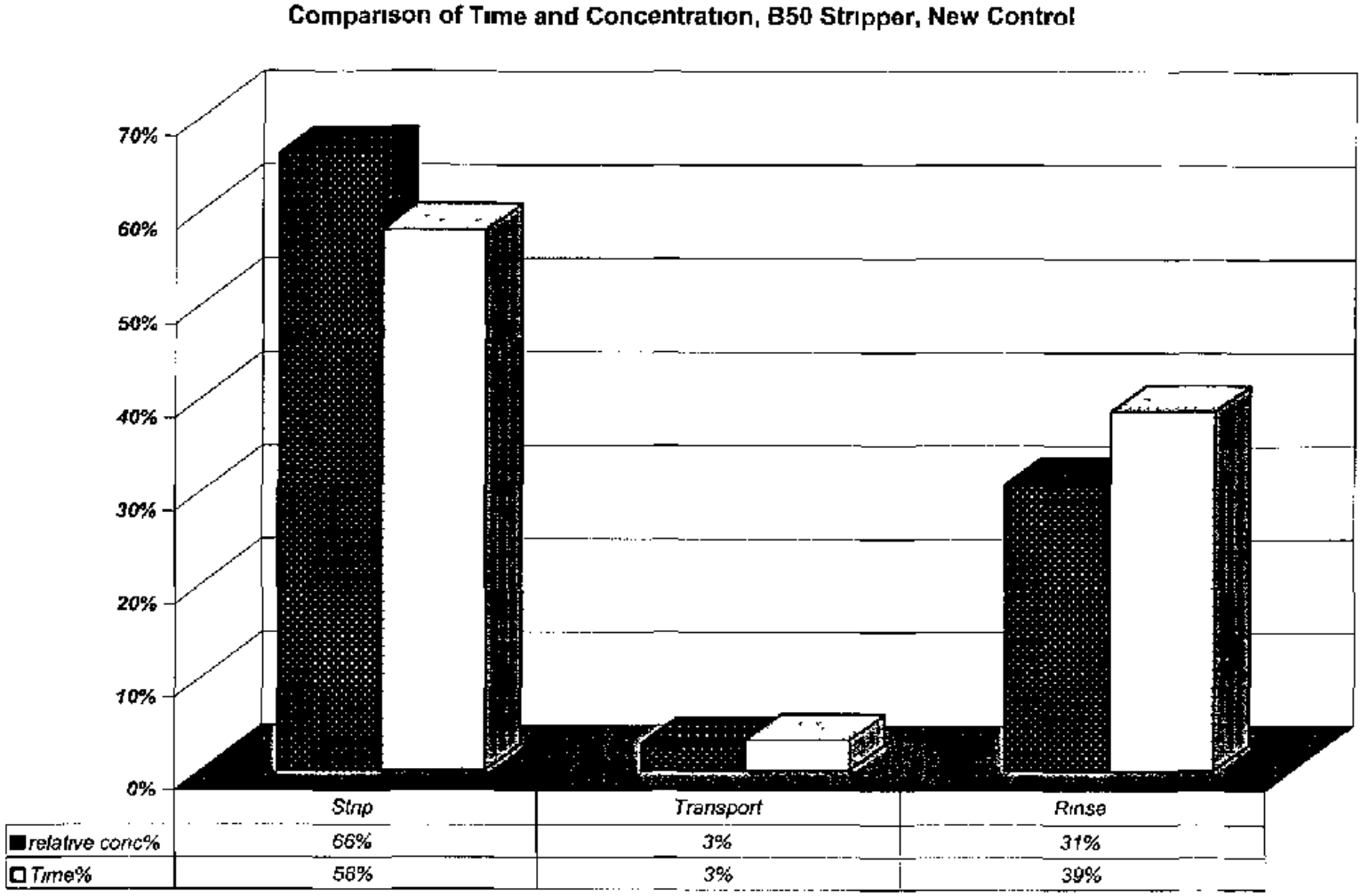
Comparison of Time and Concentration, B50 Stripper, New Control
70%
60%
50%
40%
30%
20%
10%
0%
Strip
Transport
Rinse
relative conc%
66%
3%
31%
Time%
58%
3%
39%

Figure 2