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Engineering Controls for Furniture Strippers to Meet the OSHA Methylene Chloride PEL

This case study demonstrates how methylene chloride exposures during furniture stripping can be reduced to below the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) of 25 ppm (as an 8-hour time-weighted average). Five surveys were conducted at one facility; the first four resulted in employee exposure geometric means from 39 to 332 ppm. For the fifth survey local exhaust ventilation was used at the stripping tank and the rinsing area, which together exhausted 138 m³/min (4860 ft³/min). Additional controls included providing adequate make-up air, adding paraffin wax to the stripping solution, raising the level of the stripping solution in the tank, and discussing good work practices with the employee. The employees' methylene chloride exposures during the fifth survey resulted in a geometric mean of 5.6 ppm with a 95% upper confidence limit of 8.3 ppm, which was found to be significantly lower than the OSHA PEL and the OSHA action level of 12.5 ppm. The cost of the ventilation system was \$8900.

Keywords: dip tank, furniture stripping, methylene chloride, sampling, small business

One method of commercially stripping paint, varnishes, and stains from furniture is using a dip tank. Furniture is dipped in an open stripping tank and then scrubbed to remove the finish from the crevices. The furniture is then transported to an adjacent workstation and rinsed with a high-pressure water system.

Potential chemical hazards in the furniture stripping industry are found primarily during the handling, stripping, and rinsing of the furniture. The major routes of entry of methylene chloride and other solvents into the body include inhalation of vapors and adsorption of the liquid through the skin.⁽¹⁾ Health effects studies of methylene chloride exposure have focused on four areas: effects on the central nervous system, effects on cardiovascular morbidity and mortality, induction of cancer in exposed workers,⁽²⁾ and reproductive effects.⁽³⁾ At 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 also a mild narcotic. Overexposure to methylene chloride while stripping furniture can cause death. One such incident was recently reported,⁽⁴⁾ in which

an 18-year old man was overcome by vapors and collapsed into the stripping tank.

The Occupational Safety and Health Administration (OSHA) exposure limit for methylene chloride is 25 ppm over an 8-hour time-weighted average (TWA). This exposure limit was recently reduced from 500 ppm. An action level of 12.5 ppm was also established by the new methylene chloride standard requiring exposure monitoring and medical surveillance.⁽⁵⁾

A local ventilation system had been installed on a stripping tank at an Ohio furniture stripping shop in 1991.⁽⁶⁾ No local ventilation was present in the rinsing area. The average slot velocity at the stripping tank was 975 m/min (3200 ft/min) and the exhaust volume was 82 m³/min (2900 ft³/min). Methylene chloride breathing zone samples resulted in a geometric mean of 59 ppm when alternating between the stripping and rinsing tasks. The objective of this article is to describe a case study of the same furniture stripping shop to determine if exposures could be further reduced to meet the OSHA standard. This case study includes five site visits, which included industrial hygiene measurements.

METHODS

Field Surveys

Five surveys were conducted at a furniture stripping facility from August 1997 to June 1999. The first survey was conducted to determine the current personal and area exposure levels of the existing system. The second survey was conducted to determine if exposure in the shop increased during the winter months, when the building's doors were closed. The third survey was conducted to determine if renovations to enable cleaning and lower static pressure losses on the ventilation system reduced worker exposures. The fourth survey was conducted to determine if the addition of a rinsing area ventilation system reduced worker exposures. The fifth survey was conducted to determine if employee exposures would be reduced by further renovation of the stripping tank ventilation system, providing adequate make-up air, adding paraffin wax to the stripping solution, raising the level of the solution in the stripping tank, and providing the employee with training on work practices. The second, third, and fourth surveys also were conducted to compare two different methylene chloride sampling methods.

Air Sampling

For each survey personal air samples were collected in the breathing zone of the employee during stripping and rinsing. Air samples for methylene chloride were collected using National Institute for Occupational Safety and Health (NIOSH) method 1005⁽⁷⁾ and OSHA method 80⁽⁸⁾ side-by-side. Exceptions to these methods were during the first survey, which used only NIOSH method 1005, and the fifth survey, which used only OSHA method 80. Both methods were not used during the fifth survey because on visual comparison the methods appeared to be similar. Samples that were analyzed using NIOSH method 1005 were collected on two 100/50-mg charcoal tubes (SKC, Eighty Four, Pa.) in series at a flow rate of 0.02 L/min using a personal sampling pump (Gillian LFS 113, St. Petersburg, Fla.). Samples that were analyzed using OSHA method 80 were collected on one carbosieve S-III (ORBO 91, Supelco Inc., Bellefonte, Pa.) sorbent sampling tube with a flow rate of 0.05 L/min using a personal sampling pump (Gillian LFS 113). Pumps were calibrated using a 50-mL burette as the primary standard. Area samples were collected near the stripping tank and near the rinsing area for all surveys (except the second). Additional area samples in the drying area were collected during the third, fourth, and fifth surveys. Each survey consisted of 3 to 10 runs, during each of which area and personal samples were collected simultaneously.

Data from the five surveys were combined into one data set. Analyses were carried out on the natural log scale of the breathing zone, rinsing area, and stripping area data. The residuals from the fitted model indicate approximate normality on the log scale, based on the Shapiro-Wilk test.⁽⁹⁾ The data were modeled via Proc Mixed, in SAS.⁽¹⁰⁾ The statistical model treated as a random sample from a larger population the variability of the runs by sample location. The fact that both sampling methods were used simultaneously during many runs was allowed for in the model by the inclusion of the random terms for interaction between runs within survey and sample location. The associated variance is the correlation of the errors between the two methods used on the same run. Separate means in the model were determined for each survey, each sample location, each sampling method, and interactions

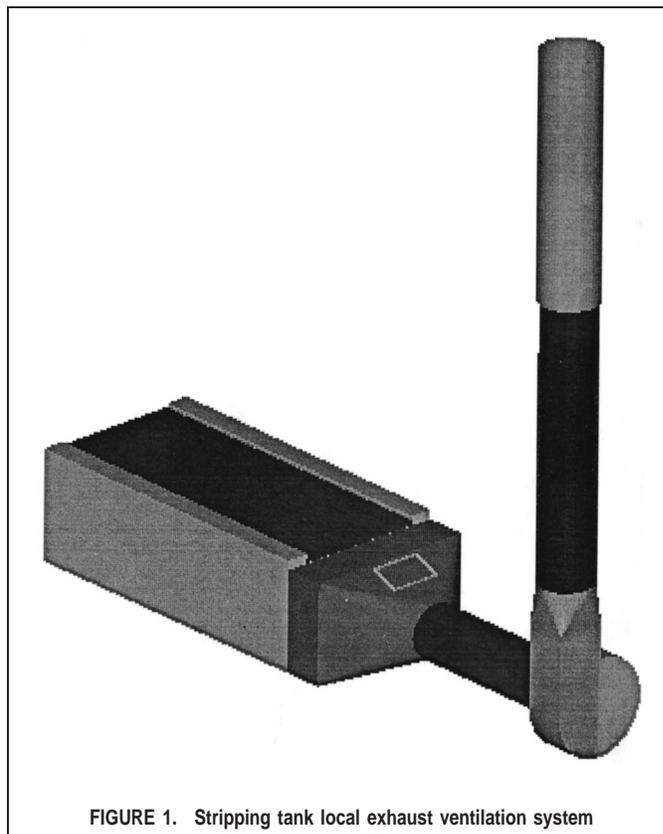


FIGURE 1. Stripping tank local exhaust ventilation system

involving these variables, although the interactions between methods and locations, and between surveys, locations, and methods were excluded because they were not statistically significant.⁽¹⁰⁾ Assessment of statistical significance is based on Student's *t* statistics.

Ventilation Assessment

The average slot velocity for the stripping tank ventilation system was recorded by measuring air velocity with a Velocicalc (TSI, model 8386A, St. Paul, Minn.) velometer at eight evenly spaced locations across each slot. The total exhaust volume of the stripping tank ventilation system was measured in the duct at eight duct diameters above the fan using the pitot traverse method with a digital micromanometer (Air Neotronics, model MP20SR, Oxford, UK). The average air velocity of the rinsing booth was measured with a Velocicalc velometer at 12 evenly spaced locations across its opening. The dimensions of the rinse booth opening were measured to compute the total exhaust volume. Doors to the facility were opened to allow for supply air during all surveys except the second.

The stripping ventilation system during the fifth survey (Figure 1) consisted of two 2-cm (3/4-inch) slots on the top edges of the front and back of the stripping tank with 23 cm (9-inch) plenums, a 60° transition piece (Figure 2) from the plenums to a 41-cm (16-inch) diameter duct, and a 41-cm (16 1/8-inch), 1.5-kW (2 HP), single phase centrifugal fan (Dayton 3C495, Niles, Ill.). There were no turns in the ductwork that was topped with a 46-cm (18-inch) vertical discharge stackhead (Figure 3). Additional features to aid in its cleaning were hinges on the exhaust plenums (Figure 4) and access holes (Figure 5).

The rinse area ventilation system during the fifth survey (Figure 6) consisted of an enclosed booth with a 41-cm (16-inch), 373-W (1/2-HP), single phase, tubeaxial fan (Dayton 4C660). The



FIGURE 2. Transition piece from plenums to duct



FIGURE 3. Vertical discharge stackhead

booth was mounted against an existing cinder block wall and was built of 0.7-mm (22-gauge) sheet metal and welding curtain (Frommelt, Weld-Tex M-1053, Dubuque, Iowa). The booth was designed so that the opening would be 0.9 by 2.0 m (3 by 6.5 ft) with a face velocity of 37 m/min (120 ft/min). Light fixtures and a rotating table were placed inside the booth.

Bulk Sampling and Task Analysis

Bulk samples of the stripping solution were collected for determining methylene chloride percentage by weight during the third, fourth, and fifth surveys. The volume of solution in the stripping tank was recorded during the fifth survey by measuring the solution height in the tank. Before the fifth survey, the stripping solution level in the tank was 61 cm (24 inches) from tank top. The composition of the added solution was similar to the original, except that paraffin wax was added. The employee added 666 L (176 gal) of methylene chloride, methanol, xylene, toluene, acetone, caustic soda flake, and paraffin wax to bring the solution up to 30 cm (12 inches) from the tank top.

The same employee performed furniture stripping for all surveys. This employee alternated about equally between the stripping and rinsing tasks. The employee was videotaped or notes were taken during the first, third, fourth, and fifth surveys to determine tasks of the worker. Additionally, during the fourth survey, real-time exposure to total solvents present in the breathing zone of the worker was measured using a MiniRae photo ionization monitor (PGM-7600, Rae Systems, Sunnyvale, Calif.) with a 10.6 eV ultraviolet lamp. The analog output signal from the MiniRae was converted to digital data by a Metrosonics data logger (model 3200, Rochester, N.Y.).

RESULTS

Methylene chloride breathing zone and area sample results are shown in Table I (the confidence intervals [CIs] allow for simultaneous comparisons). Rinse area data from survey one were



FIGURE 4. Hinges on the exhaust plenums for opening slots

not reported because only one sample was taken. Drying area samples were not used in the statistical analysis, but the TWAs using the OSHA sampling method were 8.2, 12.8, and 6.1 ppm for the third, fourth, and fifth surveys, respectively. When comparing the surveys with each other, a statistically significant reduction of 78% was shown in breathing zone exposure from the second survey to the third survey [95% CI (21%, 94%); $p=0.0036$]. One run from survey four was removed from analysis because the breathing zone samples were much higher than those from other runs.

Two of 10 breathing zone samples from the fifth survey produced nondetectable results and were replaced by concentrations

corresponding to the mass at the detection limit, divided by the square root of two.⁽¹¹⁾ The fifth survey methylene chloride geometric mean was 5.6 ppm, which was less than the OSHA permissible exposure limit (PEL) of 25 ppm (t-test, $df=25$; $p\leq 0.001$). The upper confidence limit was 8.3 ppm, less than the 12.5 ppm action limit. Survey four compared with preliminary survey four showed an estimated reduction of 85% [95% CI (59%, 94%); $p=0.0001$] for breathing zone exposure. The stripping area samples were lower than the rinsing area samples by 33%, but the difference was not statistically significant.

The NIOSH (charcoal media) and OSHA (ORBO media)

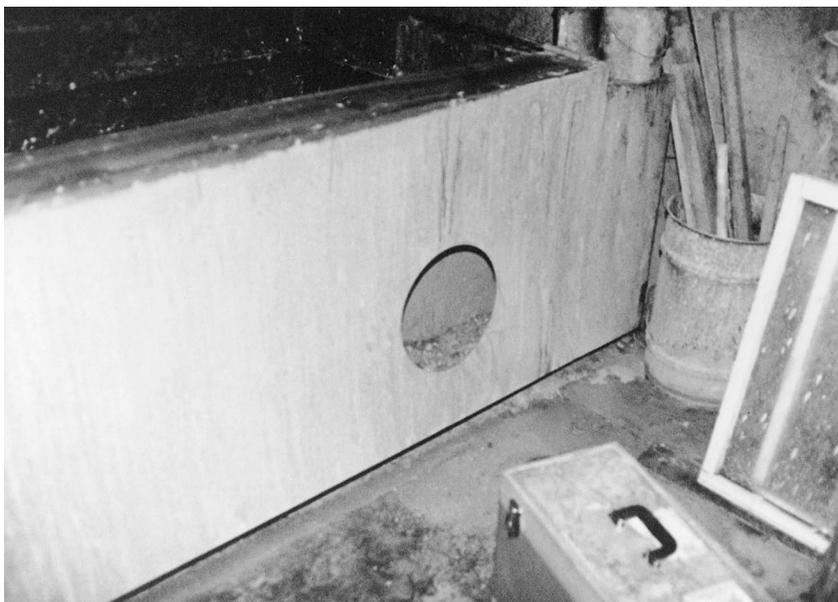


FIGURE 5. Access holes on each plenum



FIGURE 6. Rinse booth local exhaust ventilation, curtain allowed for stripping larger objects

sampling methods were compared for the second, third, and fourth surveys. Although the two methods were highly correlated, the two methods were statistically different (t-test, $df=31$, $p=0.005$). The charcoal samples were approximately 9% higher than the corresponding ORBO samples. Because of this difference, and because the ORBO samples were used for the fifth survey, a formula was devised converting ORBO sample data to a scale comparable to the charcoal sample data. The formula was based on the stripping area samples from surveys three and four because they were of similar magnitude to the breathing zone samples of fifth survey. A linear equation (Eq. 1) predicted the charcoal values given the ORBO values. The converted mean for the breathing zone samples was 6.3 ppm, with a 95% upper CI of 9.3 ppm.

$$\ln(\text{charcoal}) = 0.134 \ln(\text{ORBO}) + 0.989, \quad R=0.987 \quad (1)$$

Exhaust volumes and air velocities for the surveys are shown in Table II. Exhaust volumes were not measured during the second survey. Bulk samples of the stripping solution from the third, fourth, and fifth surveys resulted in 49%, 18%, and 50% methylene chloride by weight, respectively. The height of the solution tank (from the top) started at 30 cm (12 inches) and finished at 34 cm (13½ inches), for a difference of approximately 98 L (26 gal).

The time that the employee spent at each task and the real-time sampling results are shown in Table III. Over the surveys the employee averaged 38% of his time stripping and 41% rinsing. The output of the real-time monitor was averaged by task to determine an approximate personal exposure during each task.

TABLE I. Sampling Results

Survey	Sample Location	Number of Samples	Methylene Chloride Concentration and Simultaneous 95% Confidence Levels (ppm)		
			Geometric Mean	Lower	Upper
1	BZ (breathing zone) ^A	3	63	18	214
1	Strip ^A	3	8	2	27
2	BZ	5	332	128	864
2	Rinse	5	59	23	154
3	BZ	8	73	17	322
3	Strip	8	10	2	43
3	Rinse	8	23	5	101
4	BZ	12	39	16	99
4	Strip	12	10	4	25
4	Rinse	12	16	6	40
5	BZ ^B	10	5.6 ^C	^D	8.3
5	Strip ^B	9 ^E	4.8	^D	7.5
5	Rinse ^B	10	7.2	^D	10.6

^ASurvey one used only charcoal media.

^BSurvey five used only ORBO media.

^CThe TWA during the first day was 7.3 ppm for 228 min and for the second day was 7.4 ppm for 352 min.

^DOnly upper confidence levels were computed for survey five.

^EOne stripping sample was lost.

TABLE II. Ventilation Measurements by Survey

Survey No.	Stripping Tank		Rinse Booth	
	Exhaust Volume (m ³ /min)	Slot Velocity (m/min)	Exhaust Volume (m ³ /min)	Velocity (m/min)
1	30 (1060)	268 (880)		
2	—	—		
3	59 (2075)	517 (1695)		
4	56 (1978)	—	65 (2284)	36 (117)
5	77 (2720)	783 (2570)	61 (2140)	37 (121)

DISCUSSION

Estill and Spencer⁽¹²⁾ reported mean employee exposure to methylene chloride of 34 ppm using local exhaust ventilation at the stripping tank of 102 m³/min (3600 ft³/min). McCammon⁽¹³⁾ installed stripping and rinsing area local ventilation and reduced employee TWA exposures from 424 to 67 ppm; exhaust volumes were not reported but were estimated to be less than 113 m³/min (4000 ft³/min). Estill et al.⁽¹⁴⁾ installed local ventilation at both the stripping and rinsing areas, exhausting 59 m³/min (2100 ft³/min); employee TWA exposures were 136 ppm. None of these studies met the 25 ppm goal. Those with the lowest exposures provided local exhaust ventilation at both the stripping and rinsing areas.

The results from the fifth survey showed the employee to be in compliance with the OSHA methylene chloride standard of 25 ppm and below the action level of 12.5 ppm. Therefore, this furniture stripping facility, if continuing to use the same engineering and administrative controls, could likely meet OSHA's action level, which is important because of the added cost of the requirements if exceeded.

The rinse area ventilation was not originally as successful as hoped; it was installed between the third and fourth surveys and no statistically significant reduction was found. Exposures at the rinse area were still high during the fourth survey because large pieces of furniture often covered the entire opening and the employee sometimes went inside the booth. During the fifth survey, the rinsing area samples were lower, but still higher than the stripping area samples (although not statistically). The large furniture pieces were now opened at the back to reduce ventilation blockage. The high-pressure water nozzle could have entrained air that was moving much faster than the air velocity of the rinse booth opening. In comparison to other studies, the inclusion of rinse air exhaust ventilation was probably the most significant factor in reducing exposures below the PEL. Neither Estill and Spencer⁽¹²⁾ nor Hall et al.⁽⁶⁾ had installed rinse area local ventilation. The levels of methylene chloride in the drying area indicate that other employees working in the general area of the furniture stripping tanks should not exceed the OSHA action limit or PEL.

The significant reduction in employee exposures between surveys two and three resulted from redesigning the ventilation system to allow for cleaning and providing make-up air to the system. Before the third survey the employee was unable to clean the plenums because there was no access. Extreme deterioration had occurred in the exhaust system, exhaust slots were clogged with stripping solution, and the plenums were filled with debris. Also during this time the doors to the facility were closed with no mechanical system to bring air into the building.

During the fourth survey, the bulk sample of the stripping tank was 18% methylene chloride compared with 49% from survey three and 50% from survey five. The likely explanation for this low percentage in the stripping solution is evaporation, because no paraffin wax was used at that time. Paraffin wax forms a layer over the top of the solution that acts as a barrier to evaporation. Not using paraffin wax may have outweighed any advantages of additional local ventilation during the fourth survey. Most commercial strippers include 1% paraffin wax;⁽¹⁵⁾ even when wax was added during survey five, it was only 0.03%.

Commercial stripping solutions typically contain 70–80% methylene chloride.⁽¹⁵⁾ It is not known whether furniture strippers using higher methylene chloride content strippers could also meet the OSHA standard and action level using the engineering and administrative controls at this facility. When the methylene chloride percentage in the stripping solution falls below approximately 50%, the stripping solution becomes flammable. Commercial stripping solutions are preferred because the methods of combining wax with the solutions are known to slow evaporation and the methylene chloride content is stable.

The solution level in the tank is an important factor in determining exposure sources. Figures 7 and 8 can be compared to show that the increased height of the stripping solution during the fifth survey elevated the worker's head above the stripping tank slots and he no longer covered the slots when leaning on the tank. Keeping the solution level high in the stripping tank can also help avoid tragic accidents that could occur from extreme overexposure.

Before the fifth survey the worker watched an hour-long video of himself stripping furniture with a dynamic bar graph of his solvent exposure. This training made him aware of when his exposures were highest. This helped him keep his face out of the stripping tank and avoid walking into the rinsing booth.

The comparison between the NIOSH and OSHA sampling methods showed that the NIOSH method produced statistically higher results by about 9%. Methylene chloride typically migrates on charcoal and would be expected to be lower. It is not known why the NIOSH method resulted in higher concentrations. The NIOSH method was originally tested at concentrations above 490 ppm and may need more future testing at lower levels.

Estimated cost to build and install the ventilation system for the final survey is shown in Table IV. The second survey showed

TABLE III. Task Time and Real-Time Results

Survey No.	Type of Analysis	Stripping	Rinsing	Transport ^A	Other ^B
1	video	48 min (41%)	55 min (46%)		15 min (13%)
3	notes	92 min (38%)	153 min (62%)		
4	video	85 min (46%)	62 min (34%)	4 min (2%)	33 min (18%)
4	real-time conc	32 ppm	49 ppm	46 ppm	40 ppm
5	video	201 min (34%)	195 min (33%)		190 min (32%) ^C

^ATransport time was time spent moving furniture.

^BOther included answering phone, helping customers, and time spent out of the camera view.

^CTransport and Other were combined for surveys one and five.



FIGURE 7. Working position during survey four; note the low level of solution in the tank causing the employee to hold his head below the exhaust slots.

that a system to provide and heat make-up air during the colder months would be beneficial when the doors to the facility cannot be opened. One make-up air system that met the needs of this facility cost \$4640 (Cambridge Engineering, C390-LTR, Chesterfield, Mo.); was designed for outdoor vertical mounting; 117.kW-hr (400,000 Btus); 1.5 kW (2 HP) supply motor; 115 v; single phase; natural gas; and 113 m³/min (4000 ft³/min). Typical installation cost for this unit is about \$2200.⁽¹⁶⁾ Once installed, operating cost of this unit would be about \$1000 per year assuming the system would be running 45 hours per week.

CONCLUSIONS

This study indicated that the OSHA PEL of 25 ppm was met at this furniture stripping facility using engineering and administrative controls. Exposures also were reduced to below the action level. There were many factors that acted together to reduce exposures to these levels, the most important being the local ventilation systems at both the stripping and rinsing areas. The installation of adequate ventilation alone will reduce exposures to

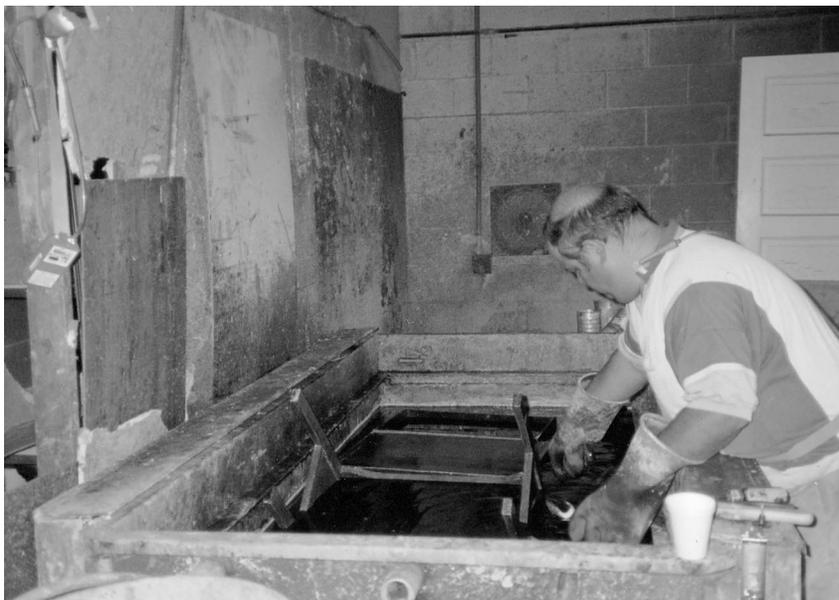


FIGURE 8. Working position during survey five; note the high level of solution in the tank allowing the employee to stand relatively erect.

TABLE IV. Cost for Ventilation System

Item	Stripping Tank Cost	Rinse Booth Cost	Make-Up Unit Cost
Material	\$2045	\$1540	\$4640
Labor @ \$50/hour	50 hours	56 hours	\$2200 ^A
Total:	\$4545	\$4340	\$6840

^AThis is the typical cost of installation. This facility would need to spend an additional \$5177 to have its natural gas line upgraded.

about 50 ppm. However, other factors need to be controlled to meet the challenging 25 ppm level: adequate make-up air needs to be supplied, paraffin wax needs to be added to the stripping solution, the stripping tank needs to be filled to a high level, and workers need to be trained in good work practices. It was not possible to isolate any one factor to determine which was most significant in reducing the employee's exposure. Installation of these engineering controls are projected to cost furniture stripping facilities \$8,900.

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REFERENCES

1. **Leung, H.W., and D.J. Paustenbach:** Techniques for estimating the percutaneous absorption of chemicals due to occupational and environmental exposure. *Appl. Occup. Environ. Hyg.* 9:187-197 (1994).
2. **National Institute for Occupational Safety and Health (NIOSH):** *Occupational Diseases: A Guide to Their Recognition*, rev. ed. (DHEW/NIOSH pub. no. 77-181). Cincinnati, Ohio: NIOSH, 1977.
3. **Kelley, M.:** Case reports of individuals with oligospermia and methylene chloride exposures. *Reprod. Toxicol.* 2:13-17 (1988).
4. **Hall, R.M., and C.F. Estill:** *Hazard Evaluation and Technical Assistance Report* (HETA 990341). Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1999.
5. **Occupational Safety and Health Association (OSHA):** *Methylene Chloride* (OSHA pub. no. 3144). Washington, D.C.: OSHA, 1997.
6. **Hall, R.M., K.F. Martinez, and P.A. Jensen:** Control of methylene chloride—furniture stripping in dip tank. *Appl. Occup. Environ. Hyg.* 10:188-195 (1995).
7. **National Institute for Occupational Safety and Health (NIOSH):** Methylene chloride: Method 1005. In P.M. Eller, editor, *NIOSH Manual of Analytical Methods*, 4th ed. (DHHS/NIOSH pub. no. 94-113). Cincinnati, Ohio: NIOSH, 1994.
8. **Burright, D.:** *OSHA Method 80, Methylene Chloride*. Salt Lake City, Utah: OSHA Analytical Laboratory, 1990.
9. **SAS Institute:** *SAS User's Guide: Basics, Version 5*. Cary, N.C.: SAS Institute, 1985. p. 1187.
10. **SAS Institute:** The mixed procedure. In *SAS/STAT Software: Changes and Enhancements Through Release 6.12*. Cary, N.C.: SAS Institute, 1997. pp. 571-702.
11. **Hornung, R.W., and L.D. Reed:** Estimation of average concentration in the presence of nondetectable values. *Appl. Occup. Environ. Hyg.* 5:46-51 (1990).
12. **Estill, C.F., and A.B. Spencer:** Case study: Control of methylene chloride exposures during furniture stripping. *Am. Ind. Hyg. Assoc. J.* 57:43-49 (1996).
13. **McCammon, C.S.:** *Hazard Evaluation and Technical Assistance Report: Ackerman & Sons, Littleton, Colorado* (HETA 92-0360-2372). Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1993.
14. **Estill, C.F., R.J. Kovein, J.H. Jones, and A. Morton:** *In-Depth Survey Report: Assisting Furniture Strippers in Reducing the Risk from Methylene Chloride Stripping Formulations at Los Angeles Stripping and Refinishing Center*. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1999.
15. **Bixenman, B.:** "Amount of Methylene Chloride and Paraffin Wax Typically Present in Commercial Furniture Stripping Solution." May 3, 2000 [Private communication] Benco Sales Inc., 123 Stout Dr., Crossville, TN 38555.
16. **Morgan Heating and Air Conditioning:** "Proposal to Install a Cambridge Make-Up Air Unit," by S. Morgan. Cincinnati, Ohio, March 16, 1999.