OSHA Compliance Issues
Overexposure and Control of Methylene Chloride in a Furniture Stripping Operation

BACKGROUND

This inspection by the Occupational Safety and Health Administration (OSHA) reports on OSHA follow-up activity where employees were overexposed to methylene chloride. The employer operated a small business with 18 workers involved in custom-made furniture repair and restoration. The exposure to methylene chloride occurred in a section of the establishment where a single employee worked 3 to 4 days per week using methylene chloride to remove paint and varnish from furniture. Using compressed air, the employee sprayed a steady stream of methylene chloride onto the piece of furniture that was sitting on a shallow tray at approximately waist height. The excess methylene chloride drained through the tray and was recirculated by a pump back into a 208-L drum for reuse. When the 208-L drum is empty it is replaced with a fresh drum of the solvent.

INTRODUCTION

The original inspection of the facility was the result of an employee complaint alleging that the workers were exposed to excessive amounts of methylene chloride in the furniture stripping operation. In this inspection, OSHA conducted personal air monitoring for methylene chloride and found that the employee was exposed to an 8-hour time-weighted average (TWA) exposure of 108 ppm. Additionally, seven short-term exposure limit (STEL) samples were collected, and OSHA found all these samples to be above the OSHA STEL. The STEL sampling results reported the following levels of methylene chloride: 285 ppm, 316 ppm, 662 ppm, 153 ppm, 634 ppm, 399 ppm, and 378 ppm. The permissible exposure limit for methylene chloride is 25 ppm as an 8-hour TWA and 125 ppm as a STEL (29 CFR 1910.1052). Sampling and analytical procedures conducted by OSHA were performed in accordance with the OSHA Technical Manual and the Chemical Information Manual.

The sampled employee was documented wearing a full-face elastomeric respirator with organic vapor cartridges and impervious gloves and an apron. From this inspection, the employer was cited for the overexposure and required to implement a variety of controls, including work practice and engineering controls, use of a NIOSH-approved supplied-air respirator, conduct air monitoring, implement a medical monitoring program, and conduct training for the exposed employees. The tray where the employee sprayed the methylene chloride onto the furniture was equipped with a back draft ventilation open-faced hood at the rear of the tray, but the duct work for the ventilation hood emptied into the work area near the ceiling. The system was not set up to vent the vapors out of the building.

OSHA Follow-Up Inspections and Consultant Reports

As a result of this initial inspection, the company informed the agency that they had initially installed a wall-mounted fan to blow air and vapors away from the...
work area and toward the ventilation hood at the rear of the spray tub. The duct work for the back draft ventilation hood had not been extended through the roof to vent to the outside air. The employer also advised OSHA that they had purchased a supplied-air respirator and required the employee to wear impervious coveralls, boots, and an apron.

Additionally, the company tried to reduce employee exposure by reducing the time spent stripping furniture. Instead of stripping the furniture throughout the workday, the employer set up a program where the furniture was stripped for 3 to 4 hours per day only. Based on information received by the employer and the fact that the employer felt he was in compliance, OSHA conducted its first follow-up inspection. This follow-up was conducted approximately 10 months following the original inspection. In the follow-up, OSHA found that the employer had essentially complied with all elements of the OSHA standard for methylene chloride, except that the personal air monitoring conducted by the agency found that the workers remained overexposed to both the OSHA PELs for methylene chloride. OSHA’s 8-hour TWA sample was 61 ppm, and two STEL samples collected reported exposure levels of 330 ppm and 380 ppm.

Based on these air monitoring results, the company contracted the services of an environmental and industrial hygiene consulting firm to perform regular air monitoring and to help the employer abate the employee exposures to methylene chloride. The consulting company conducted sampling to measure worker exposure against the 8-hour TWA and the STEL OSHA PELs. These sampling results reported an 8-hour TWA sample of 208 ppm and STEL sample of 1072 ppm, both in excess of the OSHA PELs. On the recommendation of the consultant, the employer installed a new open-faced capture hood at the far side of the stripping tank and then worked with the consultant to increase the face velocity across the hood.

The duct work at this point was extended to vent the vapor outside the building. In an attempt to create a push-pull ventilation system, additional fans were placed behind the operator to move fresh air across the breathing zone of the employees involved with furniture stripping toward the hood at the end of the stripping spray tank. The consultant also recommended that the operator work above the plane of the stripper catch basin. Further monitoring by the consultant reported reduced exposure levels, but the levels of methylene chloride remained in excess of the OSHA PELs. The employee 8-hour TWA exposure level was 44 ppm and the STEL sample was 323 ppm.

The consultant returned a month later to conduct additional monitoring for methylene chloride. In this later set of samples, the exposures actually increased. The consultant monitoring data reported an 8-hour TWA exposure of 253 ppm and a STEL sample of 442 ppm for methylene chloride. No explanation or rationale for the increased methylene chloride levels was provided in the consultant’s report. At this stage the consultant advised the employer that all engineering and work practice controls had been exhausted and that the employer would have to continue to rely on personal protective equipment. The consultant returned 2 months later to sample again for methylene chloride. In this case the samples reported an 8-hour TWA exposure level of 85 ppm; STEL samples were not collected. The consultant continued to report that further engineering controls were not feasible and the employer would need to continue to supplement the existing engineering controls with personal protective equipment.

In March of the following year, the consultant returned and collected four samples over a 3.4-hour period. The four samples reported exposures of 530 ppm, 1010 ppm, 914 ppm, and 679 ppm. The 8-hour TWA was 361 ppm; STEL samples were not collected during this consultant visit. The consultant again recommended the use of personal protective equipment to control the employee exposures.

At the request of the employer, the consultant returned in June to conduct further airborne monitoring. Personal samples collected by the consultant found employee exposure levels of 1700 ppm, 1294 ppm, 2015 ppm, and 1600 ppm collected over a 3.2-hour sampling period. The 8-hour TWA reported an exposure of 647 ppm. The consultant report did not provide an explanation for the increased airborne levels of methylene chloride; STEL sampling was not conducted. The consultant advised that the employer must continue to supplement the controls with personal protective equipment.

Three months later the consultant again returned at the request of the employer to conduct personal sampling for methylene chloride. Four samples were collected over a 3.9-hour period. The sample results reported exposures of 309 ppm, 298 ppm, 17,913 ppm, and 17,778 ppm. The 8-hour TWA exposure level was 4272 ppm. There was a note in the consultant’s report that the latter two samples may have been contaminated due to spray or a splash from methylene chloride. Based on the excess in these two samples, this is likely the case.

While the monitoring on behalf of the consultant for the employer had been taking place, the employer had remained under citation for the worker exposure to methylene chloride. The employer had also been keeping the agency apprised of the monitoring results and consultation reports. Based on results of the previous monitoring visit by the consultant, OSHA scheduled its own monitoring inspection to evaluate the status of the employers’ efforts and the extent of the employee exposure.

On the return monitoring visit by OSHA, the exposed worker was sampled for both STEL and 8-hour TWA exposures. The employee was exposed to an 8-hour TWA exposure level of 192 ppm. Three additional STEL samples were collected over the workday. Exposure levels were 300 ppm, 811 ppm, and 331 ppm. All samples were in excess of the respective PELs. Based on these results, coupled with the consultant’s sampling results and the employer’s frustration at not being able to reduce the employee exposures to levels below the OSHA PELs, the agency brought in its own experts to review work operation and make control recommendations to the employer.
OSHA Recommendations

The monitoring visit conducted by OSHA evaluated the spray operation for stripping paint and varnish from furniture. Based on its assessment of the spraying operation and the amount of methylene chloride used, the agency recommended using a combination of a slotted back draft hood coupled with a downdraft ventilation system.\(^4\)

The tray that the furniture piece was placed in for stripping measured 1.5 m by 3 m. The original back draft hood at the rear of the tray was an open-faced hood placed at the rear center of the tray and measured approximately 1.2 m wide and approximately 1.02 m in height. OSHA recommended that the employer replace the existing system with a slotted hood at the rear of the tray with a slot velocity of 2000 ft/min, which would achieve an airflow across the tray of 45 ft\(^3\)/min. The down-draft aspect of the design, according to recommendations in American Conference of Governmental Industrial Hygienists’ (ACGIH\textsuperscript{R}) *Industrial Ventilation: A Manual of Recommended Practice*,\(^4\) was the installation of a perforated plate fitted with half-inch holes and a 10% open area with a ventilation rate of 65 ft\(^3\)/min. Total flow rate for both the perforated plate and slotted hood was 5500 ft\(^3\)/min.

Following the OSHA evaluation of this work operation, the employer agreed to install the recommended ventilation system. The employer further agreed to contact OSHA once the system was in place so that OSHA could evaluate the system and perform air monitoring of the work operation. Once the system was installed, the employer contacted OSHA and the agency returned to perform air monitoring. Results of monitoring for both methylene chloride PELs found that the employer had achieved drastic reductions in the airborne exposures to methylene chloride. Sampling found that the employee was exposed at an 8-hour TWA exposure level of 1.16 ppm, and STEL exposure monitoring found that the exposure had been reduced to 5.5 ppm. Both levels were significantly below the respective OSHA PELs.

Cost Analysis and Conclusion

As part of the final OSHA monitoring visit, the agency provided the employer with a cost analysis based on the information provided to OSHA by the employer. Since the original OSHA inspection in 2001, the employer had spent $3648 on maintenance and upkeep of his respiratory protection program, $2748 on different attempts to provide engineering controls, and $3955 on contracting with a consulting firm to provide monitoring. The new ventilation system installed by the employer cost approximately $10,000. Because the new ventilation system lowered the exposures to methylene chloride to below the permissible exposure limits and action level, several of the requirements in the methylene chloride standard no longer had to be performed or implemented. This saved the company the expense of performing personal air monitoring every 3 months; respiratory protection upkeep; and additional ventilation efforts, medical monitoring, etc. The employer estimated that it would take the company 3 to 4 years to recoup the expenses paid out to control the employee exposure to methylene chloride.

As with most OSHA inspections, this case report had a positive ending owing in part to the commitment of the employer to controlling the workplace exposure. Through the employer’s consistent efforts to comply with the OSHA standards, the exposure to methylene chloride was reduced to a level where the employer was in compliance with the standard, which resulted in a safer and healthier work environment for the employees.

REFERENCES