

Dichloromethane (methylene chloride) in paint strippers: Survey of retail stores

A survey of paint stripping products at local hardware and paint stores prompted by worker deaths from dichloromethane (DCM) exposure

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I. Background and Objectives

After numerous deaths from acute exposure to paint strippers containing dichloromethane (DCM), the European Parliament voted in 2009 to ban the marketing of DCM-based paint strippers for use by the general public and professionals after June 6, 2012. DCM can now be used only in certain fixed-site industrial installations with strict safety measures. In passing the legislation banning the use of DCM in paint strippers, the European Parliament noted that:

“Paint strippers containing DCM are used by members of the general public at home to remove paints, varnishes and lacquers both indoors and outdoors. *The safe use of DCM by them cannot be ensured by training or monitoring* (italics added). Therefore, the only measure effective in eliminating the risks arising for the general public from paint strippers containing DCM is a ban, with respect to the general public, on the marketing, supply and use of such paint strippers.”¹

In contrast to Europe, DCM-based paint strippers are widely available in US retail stores for purchase by both consumers and workers. The US Consumer Product Safety Commission (CPSC) requires a cautionary label on paint strippers that indicates potential cancer hazard, an explanation of factors that contribute to risk, and safeguards such as using DCM containing products in a well-ventilated area.² Despite the labeling, however, consumers and workers may not understand that deadly levels of DCM vapors can quickly accumulate in enclosed rooms. In 1991, CPSC conducted a nationwide telephone survey of households to determine how DCM product labeling influences consumer use patterns.³ Of those who reported using DCM products, over three-quarters stated they did not change their behavior after reading directions on

¹ Decision No 455/2009/EC of the European Parliament and of the Council of 6 May 2009 amending Council Directive 76/79/EEC as regards restriction on the marketing and use of dichloromethane. *Official Journal of the European Union*, 137, 3-6. Retrieved from <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:137:0003:0006:EN:PDF/>

² Statement of Policy for Methylene Chloride, release #87-044. *U.S. Consumer Product Safety Commission, Office of Information and Public Affairs, Washington, DC, August 04, 1987*. Retrieved from <http://www.cpsc.gov/CPSCPUB/PREREL/prhtml87/87044.html>.

³ Boast L: Methylene Chloride Consumer Use Study Survey Findings. Prepared for the US Consumer Products Safety Commission, Abt Associates, March 13, 1992.

labels. In addition, over three-quarters of respondents indicated that they had no knowledge of whether products they used contained DCM.

Recently, thirteen deaths in bathtub refinishers who used paint strippers containing DCM have been reported,⁴ and the California Department of Public Health has posted two additional case reports of worker deaths related to DCM exposure.⁵ One death occurred after a DCM-based paint stripper was used to clean the baptismal font in a church, and another when a DCM-based paint stripper was used to clean the inside of a paint tank. The CPSC has also received one report of a consumer death from a paint stripper containing DCM. In this incident, a 45-year old man in Houston, Texas, died after using a DCM-containing paint stripper to remove finish from the walls of his bathroom.

After these reports of acute fatalities caused by DCM, the California Department of Public Health – Occupational Health Branch (OHB) sought to assess the availability of DCM and alternative paint strippers in a sample of hardware and paint stores. This survey was intended to inform future efforts to disseminate prevention and educational materials including up-to-date information on alternative products and methods available for paint stripping. Additionally, because precautionary labeling alone does not appear to be sufficient enough to influence behavior change, OHB was interested in learning the extent of health and safety information store workers would provide at the point of purchase. To address these questions, OHB conducted a survey of hardware and paint stores in the San Francisco Bay Area. The survey addressed availability, price, and variety of DCM-containing paint strippers and safer alternatives; store employee recommendations on safe usage; and placement of product warning labels.

II. Methods

A. Sample design & store selection

After a preliminary web-based search of stores that sell DCM-containing paint strippers, we utilized a commercial marketing database to select 165 stores in San Francisco, Berkeley, Oakland, and Richmond, CA that are likely to sell paint stripping products according to their 2002 National American Industry Classification System (NAICS) primary description. These included hardware stores (444130), paint and wall paper stores (444120), home centers (444110), department stores (452111), and nursery/garden center/farm supply stores (444220).

Due to resource and time constraints, only a limited number of stores were feasible to survey. The final sample of 25 stores was obtained using random sampling stratified by size (less than 10 employees and greater than or equal to 10 employees) and NAICS category. Randomly selected stores that were not accessible or did not sell paint strippers were replaced by another store within the same strata when possible and by convenience otherwise (Figure 1). Fisher's exact test

⁴ Fatal Exposure to Methylene Chloride Among Bathtub Refinishers – United States, 2000-2001. *MMWR: Morbidity and Mortality Weekly Report* 61(07), 119-122. Retrieved from www.cdc.gov/mmwr/

⁵ Fatality Assessment and Control Evaluation Report# 12CA002. *California Department of Public Health, Occupational Health Branch, 2012*. Retrieved from <http://www.cdph.ca.gov/programs/ohb-face/Documents/12CA002.pdf>

p-values were calculated to assess whether the sample stores were significantly different from stores not in sample based on NAICS category (listed above) and size.

B. Survey design

The survey included two components: product inventory and customer questions on paint strippers. The product inventory component was completed by the surveyor by examining store shelves to collect information on DCM-containing and alternative paint strippers, and safety equipment availability. For this survey, alternative paint strippers are defined as paint stripping products that do not contain DCM and are considered less toxic. Examples of these include paint strippers that are water-based, soy-based, or contain benzyl alcohol. It is important to note, however, that although these products are considered less toxic because they do not contain DCM, some still contain other harmful chemicals such as methanol, toluene, and N-methylpyrrolidone (NMP). Information collected on DCM and alternative products included: number of distinct products, and price/size for smallest and largest volume products. When possible, surveyors also recorded the specific brand and product names available. The product inventory survey also collected information on general observations of the store and included a space to record other observations not elsewhere addressed on the survey.

The customer questions regarding paint strippers were asked of the store worker who provided assistance, with the surveyor acting as someone interested in purchasing a product for removing paint from a bathtub. Surveyors were instructed to pose the questions as part of a conversation, without referring to the actual paper survey, and to record the store worker's responses after the conclusion of the survey. Questions addressed the following topics: recommended paint stripping product, product that works best, whether the product that works best is dangerous, how to use the product safely, availability of alternative products, whether alternative products work well, and whether alternative products are safe. For the question "How do I use this product safely?", surveyors were instructed to record specific responses on safe use (e.g., advising against use in enclosed setting) based on what the store worker said *without* prompting about specific safety instructions, to capture how a worker would respond on his/her own. This was thought to give a clearer picture of the information an average consumer would be given in this context. If the conversation allowed, surveyors were encouraged to then prompt about specific safety instructions and make note of the responses in the "comments" field in the survey.

C. Pilot testing

The survey was pilot tested by two surveyors at four separate stores - one large store and three smaller stores (with less than 10 employees). Pilot testing results revealed the need for a more standardized introduction script for the consumer questions component of the survey. The scenario of a consumer interested in purchasing a product for removing paint from a bathtub was chosen as the "worst-case scenario" for use of DCM-containing paint stripping products and the circumstances under which several of the worker deaths occurred.

Pilot testing also revealed the need for more specific instructions on how to collect data regarding the safety information provided by the store worker. To the question "How do I use this product safely?" some store workers would give instructions on using the product without safety instructions, while others would give safety instructions. To capture this difference, a

section was added for surveyors to indicate whether a clarifying question for safety tips was needed.

The finalized script includes the above changes, as well as formatting modifications to facilitate note taking and data entry. Surveys of hardware and paint stores took place in April and May 2012. The survey team consisted of an epidemiologist, preventive medicine physician, and public health associate.

D. Analysis

Data were entered into a Microsoft Access database and analyzed in SAS and Microsoft Excel.

Product inventory

The availability of DCM-containing and alternative products at each store was assessed by creating three categories of product availability at the store: 0 products, 1-2 products, and 3-5 products. The total number of stores that fit into each of these categories for DCM-containing products and alternative products were then summed. Comparing the number of stores that fit into each of these categories, by DCM-containing versus alternative product, allows for the assessment of how widely available these different products are.

To compare prices for small and large volume paint strippers, a price per ounce was calculated for the smallest and largest volume DCM-containing and alternative paint stripping product available at each store. The mean price across all stores was calculated, along with estimated 95% confidence interval based on standard deviation and t-test.⁶

Customer questions

To assess the responses to customer questions, frequency tables for each question were created. Frequency tables were also created to show the number of workers who required a clarifying question when asked, “How do I use this product safely?” and whether the worker responded with specific safety information that surveyors were listening for, without additional prompting. Regarding DCM-containing products, this information included:

- Advised against any use in enclosed setting
- Advised opening windows, using forced air entry, or using only outdoors
- Mentioned product is fatal if not used properly
- Advised use of appropriate respiratory protection
- Advised use of appropriate gloves
- Advised against layperson use/recommends only professional use
- Mentioned alternative to using stripping chemicals

⁶ Based on the estimated mean, standard deviation, and sample size, we are 95% certain that the actual mean price per ounce of the respective product types falls within the calculated 95% confidence limits.

Regarding alternative products, this information included:

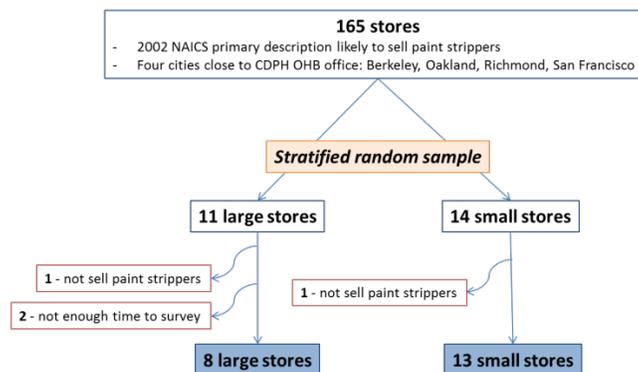
- Advised to use gloves and mask
- Mentioned toxicity of alternatives

III. Results

A. Stores sampled

There were 25 stores that were randomly selected, and 21 stores were in the final sample for analyses. Two stores did not sell paint strippers and the survey team did not have enough time to travel to two stores. The final survey completion rate was 21/25 (84%). An overview of the final sampling scheme and how stores were selected is shown in **Figure 1**. The stores were located throughout the San Francisco Bay Area (in the cities of Richmond, Berkeley, Oakland, and San Francisco) and were representative of all stores in this area by size and NAICS codes (**Table 1**).

Figure 1. Sample design and store selection



Note: Large stores have 10 or more employees, and small stores have fewer than 10 employees.

Table 1. Distribution of stores by type (NAICS description) and size (number of employees) Richmond, Berkeley, Oakland, and San Francisco (n= 21 stores in sample)

	Stores in sample		Stores not in sample		Total	P-value*
	n	%	n	%		
NAICS description						0.461
Hardware Stores	8	38.1	65	45.1	73	
Paint & Wallpaper Stores	7	33.3	39	27.1	46	
Home Centers	4	19.0	35	24.3	39	
Department or Garden Supply Stores	2	9.5	5	3.5	7	
Size						0.105
< 10 employees	13	61.9	113	78.5	126	
≥ 10 employees	8	38.1	31	21.5	39	

*Fisher's exact test p-value comparing sample to stores not in sample.

B. Product inventory

DCM-containing paint strippers were found to be more widely available than alternatives. Every store had at least one DCM-containing product, whereas 6 (30%) stores did not have any alternative products (Table 2).

DCM-containing products and prices were recorded for 20 stores, and alternative products and prices were recorded for 15 stores. The prices per ounce of the lowest volume DCM-containing and alternative products are within a similar range. For these volumes (less than 32 ounces), there appears to be alternative products within the same price point as DCM-containing paint strippers. For larger volumes, however, the price per ounce is higher for alternative products (mean price \$0.44, 95% CI \$0.33-0.54) compared to DCM-containing products (mean price \$0.26, 95% CI \$0.22-0.29) (Table 3).

Table 2. Product inventory of DCM-containing and alternative paint strippers at stores: Number of stores that carry 0 to 5 distinct DCM-containing and alternative paint stripping products (n=20 stores)

Number of products	Number of stores that carry DCM-containing products		Number of stores that carry alternative products	
	n	%	n	%
0 products	0	0	6	30
1-2 products	11	55	6	30
3-5 products	9	45	8	40

Table 3. Mean price per ounce and 95% confidence intervals (95% CI) for smallest (32 ounces or less) and largest volume products at stores, DCM-containing and alternative paint strippers

Smallest volume	n	Mean price per ounce	95% CI*
DCM containing	20	\$0.38	\$0.33 - 0.44
Alternative	15	\$0.47	\$0.36 - 0.59
Largest volume	n	Mean price per ounce	95% CI
DCM containing	20	\$0.26	\$0.22 - 0.29
Alternative	15	\$0.44	\$0.33 - 0.54

*95% CI based on standard deviation and t-test

C. Customer questions

The majority of store workers recommended DCM-containing paint strippers, and stated that they work the best to remove paint from a bathtub. Sixteen (76%) store workers recommended a DCM-containing product, while only 3 (14%) recommended an alternative product. Similarly, 19 (90%) store workers stated that DCM-containing products work best. When asked if the product that works best is dangerous, 57% said yes, while 43% said no or stated that they did not know (**Table 4**).

Knowledge about whether alternative products work well varied among store workers. Of the 15 store workers who said they do carry alternative products, 3 (20%) responded that alternative products work well, 4 (26%) said that they do not work as well as DCM, and 6 (40%) did not know (**Table 4**).

Thirteen (61.9%) workers needed to be asked a clarifying question for safety information because their initial response to the question, “How do I use this product safely?” did not mention user safety at all. Therefore, it is possible that workers and consumers with little knowledge about DCM-containing products may not receive any safety instructions from the store workers without further prompting. The majority of store workers did not mention the important safety information surveyors were listening for, which would provide product users with knowledge to use DCM products more cautiously. For example, only 20% advised against using the product in any enclosed setting, and 55% advised to open windows, use forced air entry, or use only outdoors. None of the store workers mentioned that the DCM-containing products are fatal if used improperly, that a supplied air respirator is the only type of respirator that should be worn for use with DCM, or that commonly available glove materials provide poor protection against DCM exposure⁷ (**Table 5**).

Finally, there was a range of responses from store workers to questions about the safe use of paint strippers. Formal qualitative analysis was not performed; however selected responses in **Table 6** illustrate the wide variation in the advice consumers and workers may receive when they purchase paint strippers at local stores.

⁷ Stull JO, Thomas RW, James LE: A Comparative Analysis of Glove Permeation Resistance to Paint Stripping Formulations, AIHA Journal, 63:1, 62-71, 2002.

Table 4. Customer Product Questions: Recommended and best working products

What product do you recommend for stripping paint? (n=21)	n	%
DCM product	16	76
Alternative product	3	14
Both types	2	10
Which product works best? (n=21)	n	%
DCM product	19	90
Alternative product	1	5
Both types	1	5
Is the product that works best dangerous? (n=21)	n	%
Yes	12	57
No	6	27
Don't know	3	14
Do alternative products work well? (n=15)	n	%
Yes	3	20
Not as well as DCM	4	26
No	1	7
Mixed reviews from users	1	7
Don't know	6	40

Table 5. Customer Safety Questions: Store worker responses to open ended question, “How do I use this product safely?”

	Yes		No	
	n	%	n	%
Did the interviewer need to ask a clarifying question for safety information? (n=21)	13	62	8	38
Safety instructions for DCM products conveyed without prompting (n=20)				
Advised against any use in enclosed setting	4	20	16	80
Advised opening windows, using forced air entry, or using only outdoors	11	55	9	45
Mentioned product is fatal if not used properly	0	0	20	100
Advised use of appropriate respiratory protection*	0	0	20	100
Advised use of appropriate gloves ⁺	0	0	20	100
Advised against layperson use/recommends only professional use	1	5	19	95
Mentioned alternative to using stripping chemicals	7	35	13	65
Safety instructions for alternative products conveyed without prompting (n=15)				
Advised to use gloves and mask	4	27	11	73
Mentioned toxicity of alternatives	0	0	15	100

* Store workers did not recommend the use of a supplied-air respirator. This is the only type of respirator that would protect against DCM vapors. However, supplied-air respirators are not widely available for purchase by self-employed workers or consumers at hardware and paint stores.

⁺ Common glove types that were recommended by store workers include latex, rubber, and nitrile, all of which are penetrated easily by DCM. Store workers did not recommend the use of gloves made of polyethylene vinyl alcohol (PVA). This is the only type of glove that provides protection against DCM. However, DCM eventually breaks through even this type of glove and they need to be replaced after several hours of use, before breakthrough occurs.⁸

⁸ Vahdat, N: Permeation of Protective Clothing Materials by Methylene Chloride and Perchloroethylene, American Industrial Hygiene Association Journal, 48:7, 646-651, 1987.

Table 6. Selected advice from store workers regarding DCM-containing paint strippers

Unsound advice and anecdotes
<p>“It’s not dangerous – just follow instructions on the label.”</p> <p>“JASCO is not fatal. If it were, it wouldn’t be sold on our shelves.”</p> <p>“You can just wear disposable gloves for this.”</p> <p>“A respirator is not needed because there are no fumes with this product.”</p> <p>“I wouldn’t use it in your food, but this stuff is safe.”</p> <p>One store worker was more concerned about how DCM might damage the tub, rather than the safety of the person who would be using the paint stripper.</p>
Sound advice and anecdotes
<p>“Hire a professional and do not do it yourself.”</p> <p>“This job is complicated and dangerous. You should hire a professional.”</p> <p>“You really need to read the label – this stuff is dangerous. I know how bad it can be. I’ve used it.”</p> <p>Worker recommended not using paint stripper, but sanding instead.</p> <p>“Hire a professional or buy a new bathtub.”</p>

IV. Conclusions

This survey of 21 stores assessed the availability of DCM and alternative paint strippers in retail establishments, and characterized safety information on the use of paint strippers provided to consumers in retail establishments. Major findings of this survey are that:

- DCM-containing products are more widely available in retail stores than less toxic alternatives.
- DCM-containing paint strippers do not appear to be more expensive than alternatives for small volume products (e.g. 32 ounces and below) available in stores, but alternatives are more expensive than DCM-containing for larger volumes (e.g. larger than 32 ounces).
- Safety information regarding DCM-containing products is not commonly provided to consumers at hardware/paint stores.

There are several limitations to this survey - including the small number of stores surveyed and limited geographic area. In addition, the survey did not assess consumer understanding of the hazards while using DCM-containing paint strippers, or observe actual work or home practices. It is possible that safety advice from the retail store to the consumer is only one avenue to ensure safe use. Nevertheless, the CPSC data in 1992 confirmed that many users of DCM-containing products have limited understanding of safe work practices. The present survey also did not assess the effectiveness of various products, and store personnel may not have recommended alternatives if they believe they do not work as well or have no idea if they have been evaluated for effectiveness.

In the recent workplace deaths due to exposure to DCM-containing paint strippers, the victims may not have been fully aware of the volatility of this solvent and the high concentrations that can result in enclosed spaces without adequate ventilation.^{9 10 11} In one of the occupational cases

⁹ Girman JR, Hodgson AT: Source Characterization and Personal Exposure to Methylene Chloride from Consumer Products. Presented at the 79th Annual Meeting of the Air Pollution Control Association, June 22-27, 1986.

reported in California, the employer of the victim purchased the DCM-containing paint stripper at a local hardware store. Although the label on the paint stripper warned about using with adequate ventilation and personal protective equipment, the employer was not aware of the extent to which DCM can rapidly accumulate in enclosed spaces and lead to rapid death without proper precautions. In one study that assessed product labeling and associated consumer understanding of the risks of using DCM-based paint strippers, both the labeling and reported work practices in many instances were inadequate to protect against excessive exposure.¹²

This survey suggests that DCM-containing paint strippers remain widely available in retail stores for purchase by consumers and workers. Although warning labels on these products have been required for many years, deaths from acute DCM poisoning after using paint strippers in enclosed spaces continue to occur. Although less toxic alternatives are available for purchase at the retail level, most store personnel recommended the use of DCM-containing products. Relatively little safety information was provided by the stores to the consumer about proper ventilation.

As a result of continued investigation into the use of DCM-containing paint strippers and risk of acute intoxication and death, CDPH has recently issued guidelines for selection and use of alternative products or paint removal methods.¹³ Both consumers and workers who must remove paint and other coatings from surfaces should use safer alternatives and thereby avoid the risk of serious illness or death.

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¹⁰ Hodgson AT, Girman JR: Exposure to Methylene Chloride from Controlled Use of a Paint Remover in Residences. Presented at the 80th Annual Meeting of the Air Pollution Control Association, June 21-26, 1987.

¹¹ Otson R, Williams DT, Bothwell PD: Dichloromethane levels in air after application of paint removers. *Am Ind Hyg Assoc J* 42: 56-60, 1991.

¹² Riley DM, Fischhoff B, Small MJ, Fischbeck P: Evaluating the effectiveness of risk-reduction strategies for consumer chemical products. *Risk Analysis* 21:357-369, 2001.

¹³ California Department of Public Health – Hazard Evaluation System and Information Service – Methylene Chloride is Dangerous – There are Safer Alternatives! 2012a. See <http://www.cdph.ca.gov/programs/hesis/Documents/MethyleneChlorideAlert.pdf>.