

## Fatal Exposure to Methylene Chloride Among Bathtub Refinishers — United States, 2000–2011

In 2010, the Michigan Fatality Assessment and Control Evaluation program conducted an investigation into the death of a bathtub refinisher who used a methylene chloride–based paint stripping product marketed for use in aircraft maintenance. The program identified two earlier, similar deaths in Michigan. Program staff members notified CDC’s National Institute for Occupational Safety and Health (NIOSH), which in turn notified the Occupational Safety and Health Administration (OSHA). In addition to the three deaths, OSHA identified 10 other bathtub refinisher fatalities associated with methylene chloride stripping agents that had been investigated in nine states during 2000–2011. Each death occurred in a residential bathroom with inadequate ventilation. Protective equipment, including a respirator, either was not used or was inadequate to protect against methylene chloride vapor, which has been recognized as potentially fatal to furniture strippers and factory workers (1,2) but has not been reported previously as a cause of death among bathtub refinishers. Worker safety agencies, public health agencies, methylene chloride–based stripper manufacturers, and trade organizations should communicate the extreme hazards of using methylene chloride–based stripping products in bathtub refinishing to employers, workers, and consumers. Employers should strongly consider alternative methods of bathtub stripping and always ensure worker safety protections that reduce the risk for health hazards to acceptable levels. Employers choosing to use methylene chloride–based stripping products must comply with OSHA’s standard to limit methylene chloride exposures to safe levels.

The Michigan program is one of nine state Fatality Assessment and Control Evaluation programs funded by NIOSH to identify work-related injury deaths, conduct investigations to identify contributory factors, and develop recommendations for preventing deaths in similar situations. The findings of these investigations and subsequent recommendations are summarized in narrative reports broadly disseminated to employer and worker groups and posted at the NIOSH Fatality Assessment and Control Evaluation website.\*

### OSHA Investigation

OSHA and OSHA-approved State Occupational Safety and Health Plans<sup>†</sup> conduct investigations of worker deaths and

enforce compliance with worker safety and health regulations. A review of the Integrated Management Information System (IMIS), a database for federal and state OSHA investigations, identified 12 methylene chloride–related deaths associated with professional bathtub refinishing operations during 2000–2011. One of the three deaths identified by the Michigan program was not in IMIS because the decedent was self-employed and therefore outside OSHA’s enforcement jurisdiction. The ages of the 13 decedents ranged from 23 to 57 years (median = 39 years) (Table). Twelve were male.

Ten different products were associated with the 13 deaths. Six of the products were marketed for use in the aircraft industry, the rest for use on wood, metal, glass, and masonry. None of the product labels mentioned bathtub refinishing. The percentage of methylene chloride in the products ranged from 60% to 100%.

Toxicology tests from specimens collected at autopsy indicated methylene chloride blood levels ranging from 18 to 223 mg/L in the six decedents for whom values were recorded; a level of <2 mg/L is expected in a person working within the OSHA allowable air standard for exposure to methylene chloride fumes (3). Among the five decedents whose carboxyhemoglobin (COHb) levels were tested, levels ranged from absent to mildly elevated (range: zero to 5%) (Table), indicating that carbon monoxide was unlikely to have been the primary cause of death (although the durations of exposure to methylene chloride and receipt of oxygen during resuscitation efforts, two factors that can affect COHb levels, were not known).

Analysis of IMIS data regarding deaths from methylene chloride showed an increase in cases involving bathtub refinishing since 2000. During 1976–1999, only two (8%) of all methylene chloride deaths investigated by OSHA were linked to bathtub refinishing. Since 2000, 13 (75%) of the methylene chloride deaths investigated by OSHA occurred during bathtub refinishing. Following is an illustrative case report.

### Case Report

In March 2010, the co-owner of a Michigan-based bathtub refinishing company, aged 52 years, was refinishing a bathtub in an apartment bathroom that was approximately 5 feet by 8 feet (1.5 meters by 2.4 meters) with an 8-foot (2.4-meter) ceiling. He was using an aircraft paint stripper product that contained 60%–100% methylene chloride. The bathroom ceiling had a 50 cubic feet per minute (1.4 cubic meters per

\* Additional information available at <http://www.cdc.gov/niosh/face>.

<sup>†</sup> Additional information available at <http://www.osha.gov/dcspp/osp/index.html>.

TABLE. Deaths (N = 13) from methylene chloride among bathtub refinishers — United States, 2000–2011

Date	State	Age (yrs)	Sex	Location	Stripping agent used	Coronary artery disease	Other cardiovascular disease	Carboxyhemoglobin blood levels (%)	Methylene chloride blood levels (mg/L)*
April 2000	New York	39	Male	Apartment	Not recorded	—†	—	—	—
April 2001	Texas	29	Male	Single-family home	Eldorado Paint Remover-4028	No	No	Test not performed	Positive
January 2002	Illinois	52	Male	Townhouse	Dayco Marine-Strip Heavy Duty Paint Remover	Yes	Yes	Negative	Test not performed
March 2004	Massachusetts	43	Male	Apartment	5F5 Paint and Varnish Remover	Yes	No	Test not performed	Not recorded
January 2006	Florida	36	Male	Single-family home	Klean-Strip Premium Stripper	No	No	3	223
November 2006	Maryland	23	Male	Apartment	Benco #B4 Industrial Paint Remover	No	Yes	—	Positive
May 2007	Michigan	57	Male	Apartment	Klean-Strip Premium Stripper	Yes	Yes	Negative	100
May 2008	Indiana	27	Female	Apartment	SEM XXX Finish Stripper	No	No	Test not performed	99
March 2010	Michigan	52	Male	Apartment	Tal-Strip II Aircraft Coating Remover	Yes	No	Negative	50
June 2010	New York	31	Male	Single-family home	Recochem Paint and Varnish Remover	No	Yes	<5	100
August 2010	Michigan	41	Male	Single-family home	Tal-Strip II Aircraft Coating Remover	Yes	No	Test not performed	Test not performed
February 2011	Georgia	49	Male	Apartment	Klean-Strip Aircraft Remover	Yes	Yes	Test not performed	18
September 2011	Ohio	30	Male	Apartment	Rust-Oleum Aircraft Remover	—	—	—	—

\* A level <2 mg/L is expected in persons working within the Occupational Safety and Health Administration standard.

† Information could not be obtained.

minute) ventilation fan; however, the fan was off. The man wore latex gloves and did not wear respiratory protection or use engineering controls (e.g., a local exhaust ventilation system) to vent the methylene chloride vapor.

Approximately 90 minutes after the man began working on the tub, he did not answer a call to his cellular telephone. An apartment maintenance man entered the apartment to look for the man and found him behind the closed bathroom door, unresponsive, and slumped over the tub. The maintenance man telephoned 911 and then a second maintenance man. The two maintenance men pulled the man off of the tub. The second maintenance man, a certified emergency medical technician, began cardiopulmonary resuscitation. When emergency responders arrived an estimated 2 minutes later, they moved the victim to another part of the apartment and continued resuscitation before transporting him to a local hospital. The man was declared dead at the hospital.

The decedent had a history of hyperlipidemia, and his autopsy revealed mild coronary atherosclerosis and mucus plugging of bronchi and bronchioles. His blood methylene

chloride level at autopsy was 50 mg/L. All other toxicology test results from the autopsy, including COHb, were reported as negative. The death certificate listed the cause of death as “sudden cardiorespiratory arrest due to or as a consequence of inhalation of toxic fumes.”

Based on the size of the bathroom, size of the tub, and an estimate that 6 fluid ounces (177 mL) of methylene chloride-based stripper was used during a typical job, exposure levels were estimated for both the tub and bathroom environments. The concentration of methylene chloride vapor was estimated at 92,949 to 154,916 parts per million (ppm) in the bathtub and 5,099 to 8,499 in the bathroom. The man's estimated time-weighted average exposure to methylene chloride, based on 1 hour of exposure, was 637 to 1,062 ppm in the bathroom and 11,618 to 19,364 ppm in the tub, many times greater than OSHA's short-term exposure limit of 125 ppm, 8-hour permissible exposure limit of 25 ppm, and the NIOSH immediately dangerous to life and health level of 2,300 ppm (4,5).<sup>§</sup>

<sup>§</sup> Additional information available at <http://www.oem.msu.edu/miface/10mi013report.pdf>.

**What is already known on this topic?**

Methylene chloride is a volatile, toxic, organic solvent used in cleaning and paint stripping and shown to be potentially fatal to furniture strippers and factory workers unless used in strict compliance with safety precautions.

**What is added by this report?**

Methylene chloride–based paint stripping agents used in bathtub refinishing have caused at least 13 deaths in the United States since 2000 among professional bathtub refinishers. Because of inadequate ventilation, safe use of a methylene chloride stripping agent in a small bathroom is unlikely.

**What are the implications for public health practice?**

Worker safety agencies, public health agencies, manufacturers of methylene chloride containing products, and trade organizations should clearly communicate to employers, workers, and the general public the extreme hazards of using methylene chloride–based stripping products in bathtub refinishing. Safer methods of bathtub stripping should be recommended.

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**Editorial Note**

Methylene chloride is a highly volatile, colorless, toxic chemical that is widely used as a degreaser, process catalyst, and paint remover (6). Because methylene chloride vapors are heavier than air, in the case described in this report they likely remained in the bathtub after application. To use products containing methylene chloride safely, work areas must be well-ventilated, and when levels of methylene chloride exceed exposure limits even after implementation of engineering and work practice controls, workers must use respiratory protective equipment, such as tight-fitting, full-face, supplied-air respirators (4). OSHA's standard for methylene chloride, which was promulgated in 1997, covers all occupational exposures to the chemical (e.g., general industry, shipyard employment, and construction). The standard mandates that air monitoring, medical surveillance, hazard communication, and personal protective equipment be in place where methylene chloride is used.

Methylene chloride primarily is absorbed via inhalation, although it also is absorbed effectively by intact skin. To protect against skin absorption, butyl rubber or polyvinyl alcohol gloves must be worn; latex gloves like those used in the case described in this report will not protect against skin absorption. Methylene chloride is metabolized to formaldehyde and carbon monoxide (6,7) and is categorized as a carcinogen (8).

COHb levels in the blood as great as 10%–12% can result from methylene chloride exposure (2,6). COHb levels in this range can cause headache, nausea, or dizziness. Arrhythmias have been reported at COHb levels as low as 4%–6%, angina at levels as low as 3.9%, and electrocardiographic changes at levels as low as 2.0% (6,9). In the 13 deaths analyzed in this report, the data indicate that carbon monoxide was not likely the cause of death. Because methylene chloride, like many solvents, acts as a central nervous system depressant causing narcosis at high concentrations, the decedents likely lost consciousness and died from respiratory depression. Consistent with this conclusion were the high methylene chloride blood levels at the time of autopsy found in the six persons whose methylene chloride blood levels were quantified (Table). However, because eight of the 13 decedents had cardiac disease (six with coronary artery disease and five with a cardiomyopathy or valvular disease), the arrhythmogenic effect of the methylene chloride itself or of its metabolite, carbon monoxide, might have been a contributing factor in their deaths.

Methylene chloride–based stripping products usually are applied with a paint brush or aerosol can. The products cause the bathtub coating to pucker, allowing it to be easily scraped away so that a new finish can be applied. In a small, enclosed bathroom, it is unlikely that a methylene chloride stripping agent can be used safely. Alternative methods of bathtub stripping, such as sanding, should be used. Alternative chemicals that could be used include petroleum distillates, acetate, mineral spirits, caustic paste, and acid-based formulas. However, these other methods and chemicals have their own hazards, and all employers and employees should be well aware of their risks (10). Potential worker exposures should be evaluated to determine whether the work process is safe and to ensure that workers are protected.

The findings in this report are subject to at least three limitations. First, the number of deaths identified by OSHA likely is an underestimate because the IMIS database does not include all occupational deaths and injuries (e.g., those of self-employed workers). Second, the data examined in this report are limited to workers and do not address potential risks to consumers who have access to some of these products. Finally, additional deaths

among bathtub refinishers might have been ascribed to heart disease when they were actually caused by methylene chloride.

Both OSHA and NIOSH are issuing communications regarding the risk for death from bathtub refinishing using methylene chloride strippers and the availability of safer products. The Michigan program distributed an investigation report and a hazard alert (10) after identifying bathtub refinishers in Michigan through Internet directories.

Methylene chloride also presents a risk to persons among the general public who seek to do their own bathtub refinishing. A review of the OSHA IMIS system, the Internet, and hardware stores, found 42 stripping products, 26 (62%) of which are readily available on the Internet or at local hardware stores. Many of these stripping products contain 60%–90% methylene chloride. Many Internet sites promote do-it-yourself bathtub stripping, and no state or federal restrictions exist on the use of methylene chloride stripping agents. The widespread availability of these products and their effectiveness puts both professional bathtub refinishers and do-it-yourselfers at risk. Public health agencies, worker safety agencies, manufacturers, and trade organizations should clearly communicate the extreme hazard posed by using methylene chloride–based stripping products in bathtub refinishing.

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