

Health Consultation

SCHLITZ PARK OFFICE BUILDING

MILWAUKEE, MILWAUKEE COUNTY, WISCONSIN

SEPTEMBER 13, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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HEALTH CONSULTATION

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MILWAUKEE, MILWAUKEE COUNTY, WISCONSIN

Prepared by:

Wisconsin Department of Health and Family Services
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Summary

The Wisconsin Department of Health and Family Services (DHFS) was requested by the Wisconsin Department of Commerce (DCOM) to evaluate airborne volatile organic compound exposure in an office building in Milwaukee, Wisconsin. A “cured in-place” technology was used to re-line a large diameter brick-lined sewer under an old brewery building that had been converted to an office complex. Vapor from styrene that was used in the re-lining resin entered the building through building foundation cracks both during and after a sewer re-lining project. Shortly after the start of the re-lining project, building occupants experienced irritant symptoms that were severe enough that they could no longer work in the building. A strong odor consistent with styrene was present. Measured levels of styrene exceeded the acceptable ATSDR chronic (long term) exposure levels. Strong irritant symptoms experienced by building occupants correlated with the presence of styrene and other volatile organic compounds in the building. Past exposures were therefore considered a *public health hazard*. Recommendations were made to ventilate the building basement to reduce exposure and odor. A temporary exhaust system was installed in the building basement near the point of vapor entry. Air quality data collected indicates indoor air in the office building currently represents *no apparent health hazard* for building occupants. No further action is required.

Background

Schlitz Park is an office complex converted from a 19th century brewery building. The complex houses about 1.6 million square feet of office space. It is located at 101 West Pleasant Street, Milwaukee, Wisconsin. In December 2004, DHFS was notified by DCOM of odor complaints in the Bottlehouse B building. This is a two story building of brick construction that houses several private and state government tenants, including DCOM programs. Initial investigation of the odor complaints was performed by the Milwaukee Health Department (MHD) and DCOM. It was learned that the odor was associated with a sewer re-lining project utilizing “cured in place” technology. This re-lining process uses a resin impregnated fabric that is inserted into an existing sewer line. Hot water is injected into the line to cure the resin. Styrene is a major component of the resin mixture. Other compounds such as organic peroxide initiators are also used, though in much lower proportion to styrene. According to Milwaukee Health Department, styrene odor in buildings had been associated with some re-lining projects in the past, but typically would last only a couple of days. In this case, the large diameter of the line (60 inches), its presence directly under the building, and its brick construction, may have contributed to greater vapor entry than in the past.

Following reports of occupant health symptoms, DCOM requested DHFS assistance in evaluating the exposures. DCOM reported that the odor was strong enough that after a short time in the building, occupants experienced headache and strong mucous membrane irritation. A number of occupants vacated the building on December 10 and 13, 2004. A worksite accommodation policy was in place through February 2005 because of the odor.

Air monitoring conducted by DCOM indicated that vapor entry was occurring through cracks in the basement. The building is over a hundred years old, and there were numerous cracks in the

foundation floor. The building manager attempted to seal the cracks using an epoxy-based compound. During this activity, a number of additional VOCs were introduced into the building including xylene, mineral spirits, and possibly toluene diisocyanate, which was a component of the sealing compound. DHFS performed a number of site visits from January 12 to March 28, 2005 with DCOM and MHD. Contaminant levels were monitored using direct-reading instrumentation and sample collection with laboratory analysis. Both occupant health symptoms and sampling results supported the need for exposure reduction.

Following initial reports of odor complaints, building management installed charcoal filters to remove odors and operated the ventilation system on a full day schedule. An attempt was also made to ventilate the basement by placing a large fan near a loading dock shaft. The fan was oriented to blow outside air into the basement, effectively pressurizing it. DHFS requested exhaust ventilation be oriented to depressurize either the basement or airspace below the slab. A meeting was held with building management, Milwaukee Department of Public Works, Wisconsin Housing and Economic Development Authority, Milwaukee Health Department, and Milwaukee city officials on January 21, 2005. It was learned that total cure time for the resin could be as long as 6 months. Interior inspection and tests of the lining by Milwaukee Department of Public Works indicated the interior of the lining was curing properly. DHFS and MHD issued a joint statement following the meeting that provided guidance for building occupancy criteria with respect to styrene exposure.

After subsequent air monitoring, it was apparent that vapor was continuing to enter through other cracks in the foundation including through perimeter basement walls. DHFS and MDH requested that the basement be exhausted through a fan in the window or through subsurface ventilation. By March 2005 an exhaust fan was placed in a basement window along a perimeter wall near the point of vapor entry. Soon thereafter, measured vapor levels and odors in the building began to decline. This reduction was likely further accelerated by ground thaw due to increased temperature and air exchange at shallow depth.

Occupant Health Symptoms

On December 10, 2004, a DCOM staff person reported a headache after 90 minutes in the building. A strong resin odor was also reported. Other occupants reported headache, dizziness, and eye irritation. On December 13, following the weekend, staff reported the odor made the building almost uninhabitable. On February 16 and 17, 2005 several employees reported headaches and odor complaints. A worksite accommodation policy was encouraged by DHFS and MHD. At least eleven employees were away from their work location for some portion of 17 days from December 10, 2004 to January 25, 2005. A DCOM employee who was pregnant had worked off-site voluntarily until April 2005. Intermittent reports of occupant symptoms continued through February and were eliminated after an exhaust fan was placed in a basement window.

Summary of Collected Air Quality Data

Air samples were collected on a number of occasions. The Milwaukee Health Department used an MSA photoionization detector in late December 2004 to measure total volatile organic compounds (VOCs). DCOM and DHFS used a Rae Systems PPB Rae photoionization detector to measure total VOCs. The Rae Systems PID was calibrated with an isobutylene standard before each use. A correction factor of 0.4 can be multiplied by the total VOC reading on the PPB Rae instrument to approximate styrene levels (Rae Systems). In addition, air samples were collected with SUMMA canisters for laboratory analysis to supplement the PID data and to better characterize chemical constituents. Samples were analyzed by the Wisconsin State Laboratory of Hygiene using methods EPA TO-14 (limit of detection range of 0.1 to 4 parts per billion) and OSHA PV2120 (limit of detection of 5 ppb). Results are presented in the tables below.

Volatile Organic Compounds

The highest levels of volatile organic compounds (VOCs) were observed during the period of crack sealing in the basement. The crack sealing involved the use of a product that contained toluene diisocyanate. It also involved the use of large quantities of xylene. With the exception of styrene, measured contaminant levels were generally below relevant comparison values, although odor in the building was at times quite strong.

Table 1. Summary of Total Volatile Organic Compound Data (parts per billion)

Schlitz Office Park
101 West Pleasant, Milwaukee, WI
December 2004 through March 2005

Date	Basement	1st Floor	2nd Floor	Analytic Method	Comments
12/13/05 to 12/22/05	ND	650 – 1,450	400 – 600	PID ¹ (Milwaukee Health Department)	Strong irritant symptoms reported by occupants
12/22/05	8,000	1,350 – 2,100	1,350– 1,450	PID ² (WI Dept. of Commerce)	199,000+ ppb at basement floor cracks
1/12/05	10,000 – 30,000+	500 – 1,100	500 – 1,300	PID (DCOM/DHFS)	Strong fiberglass/resin odor in building, contractors were doing crack filling in basement, 10,000 ppb in elevator shaft
1/13/05	ND	809 – 1,770	950	SUMMA Cannister OSHA PV2120 (DCOM)	# of cmpds. ranged from 22 to 40
1/18/05	1,300 – 1,600	359 – 643	ND	PID (DCOM)	Basement floor locations 553 – 199,000, large fan in basement blowing air from loading dock into basement
1/21/05	800	140 – 300	140 – 300	PID (DHFS/DCOM)	Basement floor locations 480 – 16,000+ ppb, citrus masking odor used in basement
1/21/05	353	219	ND	EPA TO-14 (DHFS)	# of cmpds. ranged from 4 to 5
1/21/05	340	861	ND	OSHA PV2120 (DHFS)	# of cmpds. ranged from 16 to 35
2/4/05	ND	170	ND	EPA TO-14 (DHFS)	Rooftop sample= 5 ppb, # of cmpds. indoors= 5, outdoors= 12
2/4/05	ND	213	ND	OSHA PV2120 (DHFS)	Rooftop= 58 ppb, # of cmpds. indoors= 11, rooftop= 7
2/7/05	ND	163 – 570	ND	OSHA PV2120 (DCOM)	# of cmpds. ranged from 14 to 20

Date	Basement	1 st Floor	2 nd Floor	Analytic Method	Comments
3/28/05	ND	225	16	OSHA PV2120 (DHFS/DCOM)	8-hour, very faint odor in lobby, none elsewhere, # of cmpds. ranged from 2 to 5

¹ MSA Photoionization detector

² Rae Systems PPB Rae photoionization detector (multiply 0.4 by the instrument reading to approximate equivalent styrene concentration)

Styrene

Styrene levels in the building exceeded the chronic (long term) minimal risk level of 60 parts per billion (ppb) on a number of occasions in January and February 2005. Samples collected on March 28, 2005 were 8 hour samples. Those data indicate that styrene in the building had diminished sufficiently to be considered *no apparent health hazard* for current exposure.

Table 2. Summary of Styrene Data (parts per billion)
Schlitz Office Park
101 West Pleasant, Milwaukee, WI
January through March 2005

Date	Basement	1 st Floor	2 nd Floor	Comments
1/13/05	ND	240 - 300	190	OSHA PV2120
1/21/05	320	200	ND	EPATO-14
1/21/05	ND	110	220	OSHA PV2120
2/4/05	ND	159	ND	EPA TO-14, rooftop sample= 2 ppb
2/4/05	ND	57	ND	OSHA PV2120, rooftop= 6.5 ppb
2/7/05	ND	29 - 47	ND	OSHA PV2120
3/28/05	ND	10	<5	OSHA PV2120

Toluene Diisocyanate

During the sealing of basement cracks by building management, a sealing product was used that contained toluene diisocyanate (TDI), a strong irritant and sensitizing agent. The crack sealing took place on January 12, 2005. A SUMMA canister sample was collected on the following day to evaluate exposure conditions. The presence of TDI was not known until after material safety data sheets were received from building management. The laboratory was not able to analyze for TDI in the January 13th sample. In response to building occupant concerns, samples specifically for TDI were collected on February 4, 2005. Samples were collected in the basement near where sealing was done and on the first floor in the DCOM conference room. TDI was not detected in either sample. Levels of detection were .0056 ppb for 2,4 TDI and 0.011 ppb for 2,6 TDI.

Exposure Pathway Analysis

Styrene was present in the re-lining resin, as were a number of other compounds such as organic peroxide initiators. Styrene presence in building air was confirmed through sample collection and analysis on multiple occasions. Photoionization detector readings along the basement floor

suggested that foundation cracks above the sewer line were the primary point of vapor entry. The elevator shaft, utility penetrations in the floor decking, and the air handling units were routes for dispersion throughout the building. Approximately 50 people work in the building. This information indicates a completed exposure pathway via inhalation exists, meaning that building occupants were exposed to the styrene release.

Public Health Implications

In summary, air in the building contained elevated levels of styrene and a mixture of volatile organic compounds at low concentrations. These levels have diminished substantially with time. Sample data has shown that air quality in the Schlitz Park office building was affected by the sewer re-lining project and that elevated VOC levels correlated to strong irritant symptoms experienced by building occupants. These symptoms were strong enough that a number of occupants had to leave the building on several occasions. This exposure therefore represented *a public health hazard*. The data also indicate that levels have since diminished sufficiently and currently represent *no apparent health hazard*.

Styrene

Styrene is a common chemical component used in rubber and plastics industries to make packaging, insulation and fiberglass products. It is also associated with combustion processes such as automobile exhaust and cigarette smoke. The odor threshold for styrene has been reported to be 50 parts per billion (Plog 1988). It has been described as having a sweet, sometimes irritant odor. It is slightly soluble in water and is volatile. The most common health effects associated with styrene exposure are mucous membrane irritation and central nervous system effects (e.g. depression, concentration problems, muscle weakness, tiredness, and nausea). Recovery from short term effects is typically rapid upon removal from exposure (ATSDR 1992).

A review of the ATSDR toxicological profile for styrene indicates health effects in multiple organ systems including neurological, kidney, and liver have been associated with styrene exposures in animal and human studies. Studies of developmental and reproductive effects in humans have been inconclusive, although some effects have been observed at high concentrations in animal tests. The lowest concentration at which adverse effects were observed in short term studies (less than two weeks) was 55,000 parts per billion (ppb) at which slowed reaction time was observed in human subjects. However, it is unclear whether simple irritant effects were considered in these studies. For intermediate exposure durations (2 weeks to one year), liver enzyme alteration was observed in rats exposed to 300,000 ppb. For chronic studies (greater than one year), decreased verbal learning skills were observed in human subjects exposed to 26,000 ppb. The minimal risk level (MRL) for chronic exposure of 60 ppb is derived from this study. The MRL was calculated by adjusting the 26 ppm derived from an occupational study and adjusting for 7 day a week, 24 hours a day exposure. An uncertainty factor of 100 was also applied to account for the use of an adverse effect being used as an endpoint and for human variability. Considering an occupational exposure timeframe, the MRL would be 260 ppb. The MRL is a level of exposure for which exposure is not expected to result in adverse health effect.

Some studies have suggested an increased risk of leukemia, though the significance of these findings have been questioned. The International Agency for Research on Cancer (IARC) classifies styrene as possibly carcinogenic to humans based on increased rates of mammary tumors in animal tests. There is little information available on the fetal, developmental or reproductive effects of styrene exposure, particularly at low concentrations. However, because there are indications of possible effects in industrial workers and in animal tests at high levels of exposure, it is prudent to minimize exposure.

There is no minimal risk level available for acute or intermediate exposures to styrene. The American Conference of Governmental Industrial Hygienists (ACGIH) TLV is 20 ppm based on neurotoxicity, irritation and central nervous system effects (ACGIH 2003). The OSHA permissible exposure level is 100,000 ppb. As a general rule, occupational exposure values have sometimes been reduced by a factor of 10 when applied to non-occupational settings. In this case 2 parts per million was selected as an appropriate short term exposure level that would define exposure acceptable for building occupancy. This level was lower than that calculated from the TLV if it were adjusted for full-day and week-long exposure. In this case exposure of all occupants was on the order of 8 hour workshifts. Further, there were no indications in cited toxicological data that adverse effects were observed at this level of exposure. Because occupant health symptoms were consistent with styrene exposure, *past exposures were considered a public health hazard* and warranted reduction efforts. Styrene levels above 200 ppb were measured in occupied building locations more than one month after the start of the re-lining project. Sampling data collected since corrective action has been taken suggests levels have substantially reduced and *currently represent no apparent health hazard*. The last recorded styrene levels were 10 ppb and non-detect on the first and second floor respectively.

Volatile Organic Compounds

Volatile organic compounds (VOCs) are those chemicals containing carbon that evaporate readily at room temperature and pressure. Because they evaporate readily they often represent health and safety concerns. This is due to their ability to be easily inhaled and because they are often flammable. Many VOCs are known carcinogens. Toxicity data is available only for a limited number of organic compounds to which we are exposed. This presents challenges in assessing the risk of multiple exposures.

The majority of compounds detected in the Schlitz Park office building were present either in low part per billion (ppb) quantity or below the limit of quantitation, typically 5 ppb. Higher levels were observed during crack sealing operations, but no individual component exceeded one part per million. In most cases these compounds were well below relevant comparison values or comparison values were not available. There are no regulatory standards that define acceptable exposure levels to combined low level volatile contaminants in non-occupational settings. As general guidance for indoor air quality, a level of 3 milligrams per cubic meter or 1,000 part per billion has been proposed as a level above which building occupants may experience discomfort (Molhave 1990). This level was approached or exceeded in the Schlitz Park office building in December and January evidenced by samples collected on four occasions. This level of exposure

represents *no apparent public health hazard*. However, it is possible that such exposure may contribute to discomfort of building occupants. The most recent test results suggest both the number of compounds detected and the level of compound presence has diminished substantially.

Risk Communication

Meetings were held with building occupants on January 21, 2005 and February 4, 2005. Joint statements with Milwaukee Health Department were issued on several occasions responding to building occupant questions and concerns.

Conclusions

Indoor air in the Schlitz Park Office Park building contained airborne styrene levels above guidelines for long-term exposure as well as other volatile organic compounds. Building occupants reported strong respiratory and mucous membrane effects consistent with elevated VOC levels in the building. Therefore, *past conditions at the site are classified as a public health hazard*.

Ventilation and ground thaw seem to have reduced and accelerated dissipation of residual styrene below the building foundation. Recent data indicates building air quality *currently represents no apparent public health hazard*.

Recommendations

Recent sampling data indicates that no further action is required. Basement ventilation was effective in reducing exposure to building occupants. Complete curing of the resin pipe lining will further limit any potential future exposures.

Public Health Action Plan

DHFS has recommended that the basement exhaust fan be left in place for several weeks for use in the event that odors return. It is anticipated that ground thaw, dissipation of residual vapor and final curing of the sewer lining resin will eliminate the need for any further action to control odor and exposure.

References

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CERTIFICATION

This Schlitz Park Office Building Health Consultation was prepared by the Wisconsin Department of Health and Family Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health consultation was begun. Editorial review was completed by the Cooperative Agreement Partner.

Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Team Leader, CAT, SPAB, DHAC, ATSDR