HEALTH CONSULTATION

Mid-Michigan Mercury Floor

Middleton Gratiot County, Michigan

Prepared by

Michigan Department of Community Health
Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry

BACKGROUND AND STATEMENT OF ISSUES

On March 11, 2004 the MDCH received a call from the Superintendent for the Fulton Elementary School located at 8060 Ely Highway in Middleton, Michigan, approximately 30 miles north of Lansing. The school was in the process of replacing the surface of their gymnasium floor and had submitted samples of the material for analysis following the directions of the Michigan Department of Environmental Quality. The vinyl-like floor surface was approximately 35 years old and had been formulated and poured with mercury as an ingredient to facilitate the liquid's spreading and leveling. The MDEQ required a Toxicity Characteristic Leaching Procedure (TCLP) test on the floor surface material since it is considered a toxic waste. It is not ignitable, corrosive or reactive but its toxicity needs to be known in order to determine if it could be sent to a type II or type III landfill, or must go to a hazardous waste landfill. The test showed the material exceeded the 0.200 milligram per liter (mg/L) standard for mercury with a sample result of 1.5 mg/L. The school was already in the process of making arrangements with a contractor who would remove, transport and dispose of the flooring in an approved manner.

The Superintendent was calling MDCH to seek our advice and assistance in determining if the floor and the removal process posed any health hazard to the children and staff of the school. The potential for current and future exposure to mercury vapors emanating from the floor were the health issues that prompted the request for this consultation.

MDCH staff visited the school on the afternoon of March 11 and brought MDCH's Lumex® RA-915+ Mercury Vapor Analyzer. The staff member arrived at the school and was escorted to the gymnasium where the Lumex was started and allowed to acclimate to the room's temperature which was approximately 70 degrees Fahrenheit. The staff member ran an internal test on the machine and found it to be operating correctly. The staff member then started taking air samples 3 to 4 feet off the surface of the floor, a level that approximated the breathing zone for the young people who frequent the gymnasium. About a dozen students were playing ball in various areas of the gymnasium so the MDCH staff member went to a remote area of the room and began testing near the floor surfaces. The results, reported in nanograms per cubic meter of air are listed in Table 1 below.

Table 1.

Sample Location	**Measurement** (ng/m3)
Gymnasium breathing zone (bz)	42 to 50
Sample taken on unbroken floor surfaces	50 to 90
Near distressed edge of material , side of room	117 to 249
1"above 4"round hole in material	2,900 to 8,900
Under flap of floor surface near hole	17, 000
School office bz	7
Hallway bz	7
Second floor (above gymnasium) bz	21

In speaking to school staff, the staff member learned that the floor had been in place for approximately 35 years and was thought to have been formulated by a Scandinavian company. In a phone call to the contracting firm who was the leading candidate for the removal, MDCH investigated possible suppliers of such flooring and found two mercury bearing products Tartan Floors®by the Minnesota Mining and Manufacturing Company and Chemturf® made by Robbins Sports Surfaces. MDCH was unable to definitively determine the manufacturer of the floor but did find a Public Health Consultation done by the Ohio Department of Health in 2002 on a similar flooring investigation involving mercury.

Discussion

MDCH frequently receives requests to assist with elemental mercury investigations and is prepared to help in several ways. As in this case, MDCH will use our equipment to determine if a mercury bearing-material is giving off mercury vapor in quantities that pose a health hazard. Staff can also quickly fax or email procedural guidance to the caller who has had a spill which includes information on addressing small or large spills, sample press releases, sample letters to parents, patients and employees. Our response can include bringing in and coordinating the resources of other agencies such as ATSDR, the U.S. EPA Emergency Response Branch and the Michigan based Poison Control Centers. We are also able to give guidance on containing spills, managing the cleanup, and evaluating the need for biological sampling of exposed and potentially exposed people. We have assisted local health departments in drafting letters to home and business owners after the event for insurance coverage purposes.

The routes of exposure for elemental mercury are ingestion, dermal absorption and inhalation of mercury vapors. Of the three, inhalation is the most hazardous route, particularly to children and women of childbearing age. In this case, the exposure pathway was complete. The students and the teacher were exposed via inhalation in the school gym. However, the level of mercury at which exposure occurred was very low.

Inhalation of high levels of elemental mercury can cause permanent neurological damage and kidney impairment. The Agency for Toxic Substances and Disease Registry (ATSDR) recommends that breathing zone mercury levels not exceed 1,000 ng/m^3 for long term exposures as would be likely in a residence, nursing home or other place where people spend a large amount of time.(1). This recommended level is based on both animal studies and human epidemiology studies that describe the health effects of inhalation of mercury-contaminated air. Workers who were exposed to mercury vapors in an occupational setting exhibited hand tremors, increases in memory disturbances, and slight subjective and objective evidence of autonomic nervous system dysfunction. The ATSDR minimal risk level (MRL) for mercury in air was derived from the lowest observed adverse effect level (LOAEL) from this study of 26,000 nanograms of mercury per cubic meter of air (ng/m^3). Because workers were only exposed during working hours, the LOAEL was adjusted to account for continuous exposure. The resulting value was divided by an uncertainty factor of 10 to protect sensitive human subgroups and by a factor of 3 because a LOAEL was used rather than a no observed adverse effect level (NOAEL). The resulting MRL is 0.2 micrograms per cubic meter (ug/m^3) or 200 ng/m^3. An MRL is defined as an estimate of the daily exposure level to a hazardous substance that is likely to without appreciable risk of adverse, non-cancer health effects. **The ATSDR recommended**

value for residential setting of less than 1000 ng/m^3 is an action level that if exceeded would prompt the need for further cleanup or other remedial action.

The breathing zone values measured on March 11 were all lower than 50 ng/m3. If the gymnasium were full of people attending a sporting event, it would be reasonable to expect that the ambient air temperature might be warmer than on the day MDCH was there. The closer to the flooring material that air samples were taken the higher the readings were. The highest level measured, 17,000 ng/m3, was taken in an area where the damaged pocket of flooring, separated from the concrete floor beneath, had accumulated a headspace of mercury vapor.

Addressing the Unique Vulnerabilities of Children

Children may be at greater risk than adults from certain kinds of exposure to hazardous substances at sites of environmental contamination. They engage in activities such as playing outdoors and hand-to-mouth behaviors that increase their exposure to hazardous substances. They are shorter than adults, which means they breathe dust, soil, and vapors close to the ground. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. The developing body systems of children can sustain permanent damage if toxic exposures are high enough during critical growth stages.

Children exposed to similar amounts of mercury vapor as adults may receive larger doses because of greater lung surface area relative to their body weight. Their lower body weight and higher intake rate can result in a greater dose of mercury per unit of body weight. Children tend to be shorter in stature than adults, thus their breathing zone is nearer the floor where higher mercury levels are typically found. Children also engage in activities such as crawling and rolling around on the floor. Given that mercury affects the nervous system and that the neuropathways of children (<15 years old) are still developing, children can sustain permanent damage if the mercury exposure attains toxic levels during critical growth periods.

Children who inhale significant amounts of metallic mercury vapors may develop a disorder known as acrodynia, or “pinks disease.” The symptoms of this disorder include severe leg cramps; irritability; and abnormal redness of the skin, followed by peeling of the hands, nose, and soles of the feet. Itching, swelling, fever, fast heart rate, elevated blood pressure, excessive salivation or sweating, rashes, fretfulness, sleeplessness, and /or weakness may also be present. This disorder may occur, in some cases, when exposure lasts for only a few days. Since the levels found in the gym are relatively low, none of these symptoms are expected in this case.

CONCLUSIONS

Based on the sampling data, the mercury vapor measured in the gym was not of sufficient concentration to pose a health hazard to anyone using the facility even for extended periods of time. MDCH concluded that there was no apparent health hazard from mercury in the Fulton Elementary School gymnasium at that time.

The actions associated with removal of the mercury-containing material could increase mercury vapor levels to concentrations of concern and therefore pose a health hazard in the future.

RECOMMENDATIONS

MDCH recommended the following to the school and to the contractor who would be involved in the removal of the flooring material.

1. During the removal there should be no person present except those involved in the removal and they should be using personal protection and safety equipment suitable to the task.
2. The room should be thoroughly ventilated to the outdoors to exhaust residual mercury vapors after the flooring and any contaminated residue has been removed from the gymnasium.
3. The levels of mercury vapor in the room should be checked with a Lumex® or an equivalently sensitive mercury vapor analyzer before any replacement flooring is installed.

PUBLIC HEALTH ACTION PLAN

MDCH verbally notified the Superintendent of the investigation results.

MDCH contacted the contractor the school was considering for the removal of the floor after the school year has ended. They discussed remedial actions and health and safety measures associated with the removal.

MDCH offered to clearance test the gymnasium after the removal, prior to the installation of a new floor and reuse of the facility.

MDCH remains available to address any public health questions or concerns regarding this contamination event for parents, administrators, or other concerned individuals. Please contact the Michigan Department of Community Health, Division of Environmental and Occupational Epidemiology at 1-800-648-6942.

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References

- ATSDR (Agency for Toxic Substances and Disease Registry). 2000. Suggested Action Levels for Indoor Mercury Vapors in Homes or Businesses with Indoor Gas Regulators.

- ATSDR (Agency for Toxic Substances and Disease Registry). 1999. Toxicological Profile for Mercury, Update.

- Ohio Department of Health, 2002, Health Consultation , Mercury Exposures from 3M Tartan Brand Floors, Westerville School

CERTIFICATION

This Mid-Michigan Mercury Floor Health Consultation was prepared by the Michigan Department of Community Health 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 health consultation was begun.

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Technical Project Officer, SPS, SSAB, DHAC, ATSDR

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

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Chief, State Program Section, SSAB, DHAC, ATSDR