

Health Consultation

MONROE TOWNSHIP GROUNDWATER CONTAMINATION SITE

MONROE TOWNSHIP, GLOUCESTER COUNTY, NEW JERSEY

CERCLIS NO. NJD980769699

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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

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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Prepared by:

**Exposure Investigation and Consultation Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry**

Background and Statement of Issues

The Environmental Protection Agency (Region 2) requested ATSDR review well water sampling results collected from Monroe Township in Gloucester County, New Jersey. The purpose of the review is to determine if levels of benzene, mercury, and tetrachloroethylene in well water represent a public health concern from dermal and inhalation exposure during showering.

EPA tested approximately 100 private wells in Monroe Township for metal and volatile organic compounds. Well water samples from thirteen homes contained tetrachloroethylene ranging from 0.008 to 1.5 milligrams per liter (mg/L). Samples from three homes contained more than 0.5 mg/L of tetrachloroethylene. One sample from a business contained 0.47 mg/L of benzene.

Samples collected from 6 homes contained mercury above the EPA Maximum Contaminant Level (MCL) of 0.002 mg/L. The mercury concentrations in these homes ranged from 0.0033 to 0.0199 mg/L. MCLs, maximum contaminant levels, are the maximum permissible level of a contaminant in water delivered in a public water system. Primary MCLs are established by the EPA to protect against illness resulting from ingesting drinking water contaminants. EPA has the authority to enforce MCLs on operators of public water supply systems.

Well water samples collected from several homes contained thallium and copper above their respective MCLs and lead above its action level. EPA is currently investigating the source of these contaminants in order to determine whether a long-term removal action is necessary.

Residents of homes found to contain contaminants above their respective MCL or action level have been supplied with bottled water. EPA will be installing point of entry treatment systems for those private wells containing tetrachloroethylene and benzene above their respective MCLs.

Discussion

From showering in tetrachloroethylene-contaminated water, a resident may be exposed to tetrachloroethylene from (1) release of tetrachloroethylene into air and subsequent inhalation and (2) absorption through the skin. A resident could inhale the tetrachloroethylene while showering and while standing in the bathroom immediately after showering.

Studies in humans have demonstrated that the dermal absorption dose of chlorinated volatile organic compound (chloroform) is comparable to the shower inhalation dose [1].

ATSDR made the following assumptions to estimate tetrachloroethylene exposure to residents who are showering with tetrachloroethylene-contaminated water:

- (1) a resident would take a 10 minute shower once per day, and
- (2) a resident spends an additional 15 minutes in the bathroom after showering.

The maximum concentration of tetrachloroethylene in the bathroom can be estimated by the following mathematical formula [2]: $C_a = \frac{k \times t \times C_w \times F}{V}$

where:

C_a = air concentration in milligrams per liter

F = flow rate in liters per minute (assumed to be 8 liters per minute)

k = volatile mass transfer coefficient in liter per minute (conservatively assumed to be .9)

C_w = tetrachloroethylene concentration in tap water in milligrams per liter (0.5 mg/liter)

t = shower time in minutes (10 minute shower)

V = bathroom volume in liters (assumed to be 10,000 liters)

If the concentration of tetrachloroethylene in the shower water is 0.5 mg/liter, the maximum concentration of tetrachloroethylene in the bathroom air is estimated to be 3.6 milligrams per cubic meter (3.6 mg/m³) or 0.53 ppm (6.78 mg/m³ = 1 ppm). If the shower water concentration is 1.5 mg/liter, the maximum air concentration is estimated to be 1.59 ppm.

Assuming an adult breathes 1.0 cubic meter of air per hour and the water concentration is 0.5 mg/liter, the estimated exposure during showering and subsequent bathroom use are as follows:

$$\text{shower inhalation dose} = (3.6 \text{ mg/m}^3) \times (1.0 \text{ m}^3/\text{hr}) \times (10/60 \text{ hr}) = 0.6 \text{ mg}$$

$$\text{sink inhalation dose} = (3.6 \text{ mg/m}^3) \times (1.0 \text{ m}^3/\text{hr}) \times (15/60 \text{ hr}) = 0.9 \text{ mg}$$

$$\text{shower dermal dose} = \text{shower inhalation dose} = 0.6 \text{ mg}$$

$$\text{total dose} = \text{shower}_{\text{inh}} + \text{sink}_{\text{inh}} + \text{shower}_{\text{der}} = 2.1 \text{ mg/day}$$

The estimated total tetrachloroethylene dose is 6.3 mg/day using this model at the shower water concentration of 1.5 mg/liter.

This model estimates a worst case concentration since it does not take into account dilution ventilation in the bathroom, and it assumes exposure at maximum air concentration throughout duration of the bathroom use. The tetrachlorethylene concentration will gradually increase to a maximum at the end of the shower then gradually decrease once the shower is turned off.

ATSDR has established an acute inhalation MRL of 200 ppb and a chronic inhalation MRL of 40 ppb for tetrachloroethylene. The lowest observed adverse effect level (LOAEL) for acute inhalation exposure to tetrachloroethylene is 50 ppm [3]. This is also the basis for the acute MRL. Humans exposed to 50 ppm for 4 hours were observed to have neurological effects (i.e. slight loss of visual contrast). This effect was not observed at 10 ppm. At water concentration of 0.5 mg/liter, the predicted maximum air concentration of 0.53 ppm during showering is

approximately 100-fold less than the LOAEL. At a water concentration of 1.5 mg/liter, the predicted maximum air concentration is 1.59 ppm.

The 40 ppb MRL (chronic) is based on increased reaction times in dry cleaning workers exposed to 15 ppm for ten years. This MRL includes an uncertainty factor of 100. Exposure to tetrachloroethylene at the 40 ppb (0.271 mg/m³)- MRL (chronic) is equivalent to a 6.5 mg per day dose for an adult breathing one cubic meter of air per hour for 24 hours. The estimated total daily dose (inhalation and dermal) from shower-bathroom use is approximately one third of the inhalation dose of exposure at the chronic MRL when the shower water contains 0.5 mg/liter. The estimated total daily dose is approximately equal to the inhalation dose of exposure at the chronic MRL when the shower water contains 1.5 mg/liter of tetrachloroethylene.

Only one private well (a cement vault manufacturer) contained 0.47 mg/L of benzene in its well water sample. Assuming that employees took showers at this facility, the maximum concentration of benzene in the bathroom air is predicted to be 1.1 ppm. This value is above the American Conference of Governmental Industrial Hygienists (ACGIH®) Threshold Limit Value (TLV) of 0.5 ppm for the duration of the shower and bathroom use. TLVs ® are the concentrations of air contaminants to which nearly all workers can be exposed to for a conventional 8 hour workday without adverse health effects. If employees had no other exposure to benzene during the workday, their actual time weighted exposure would be less than the TLV. The predicted air concentration from showering is less the ACGIH® Short Term Exposure Limit (STEL) of 2.5 ppm. The STEL is the air concentration that workers can be exposed to for short period of time (15 minutes) without suffering the following adverse effects: irritation, tissue damage, or narcosis. However, additional occupational exposure to benzene could occur from the use of benzene-contaminated well water in the manufacturing of cement vaults. ATSDR cannot determine the level of benzene exposure without additional information on how the well water is used in the manufacturing of vaults.

The evaporation of elemental mercury in contaminated residences has resulted in mercury vapor in air at levels of health concern [4]. However, mercury does not typically exist in its elemental form in nature[5]. Additionally, there are no reports of mercury vapor exposure resulting showering with mercury-contaminated in the public health literature. As a result, ATSDR cannot evaluate the potential inhalation and dermal exposure of mercury from showering and bathroom use without additional information, i.e, the form of mercury found in the ground water.

Conclusions

The predicted dose of tetrachloroethylene from showering and bathroom use represents no apparent public health hazard to residents of the Monroe Township Site.

The benzene levels in well water at the cement vault business represent an indeterminate public health hazard for non-ingestion use. If the usage of this dwelling changed from business to residential, the predicted level of benzene exposure may represent a health concern to more sensitive (non-occupational) populations.

Recommendations

ATSDR believes that there are enough uncertainties in the available health literature regarding tetrachloroethylene to warrant precaution. The recommendations listed below identify actions that ATSDR believes are prudent to reduce further any potential health hazards that might be associated with tetrachloroethylene exposure in the affected area of Monroe Township. These measures are also prudent since the implications of mercury exposure from showering and dermal contact have not been evaluated.

- Reduce inhalation and dermal exposure during showering by using existing bathroom exhaust fans and increasing natural ventilation (opening windows where possible), and limiting duration of showers.
- Continue to supply alternate source of drinking water to residents whose well water contains contaminants in excess of primary drinking water standards and action levels.

These actions are recommended until the appropriate water treatment systems have been installed in affected homes.

Please contact Peter Kowalski at 1-888-422-8737 or 404-639-0616 if you have any questions regarding this health consultation.

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