MassDEP Fact Sheet

1,4-Dioxane in Drinking Water: Questions and Answers

What is 1,4-dioxane?

1,4-Dioxane is a clear liquid used as a solvent in the manufacture of chemicals. It has historically been used as a stabilizer in chlorinated solvents. It can be found in paint, adhesives, pesticides and some consumer products such as household cleaners, detergents, shampoos, deodorants and cosmetics. Its main industrial use is in degreasing solvents where it is present in combination with other chemicals.

Note: 1,4-dioxane and "dioxin" are not the same chemical and have different health effects.

How does 1,4-dioxane get into water?

1,4-Dioxane can get into water from industrial uses and accidental spills. Another possible source includes landfill leachate as a result of the disposal of waste products containing 1,4-dioxane. Due to its presence in consumer products, it can leach into groundwater from septic systems or be released into the environment in treated wastewater. Once released into the environment, it can enter ground or surface water used as drinking water.

How is 1,4-Dioxane discovered in drinking water?

1,4-Dioxane has been found in groundwater supplies across the US as a result of recent testing of public drinking water supplies required by the United States Environmental Protection Agency (USEPA) *(For more information, please see: http://water.epa.gov/lawsregs/rulesregs/sdwa/ucmr/ucmr3/basicinformation.cfm).* Sometimes it is found from the testing of private or public drinking water supplies close to potential 1,4-dioxane sources, including landfills, wastewater discharges and hazardous waste sites.

How might I be exposed?

People can be exposed to 1,4-dioxane by drinking or using water that is contaminated with it to make beverages such as tea, coffee or formula or when cooking foods that retain water (i.e., oatmeal). Significant exposures during showering or bathing do not occur as 1,4-dioxane is not absorbed through the skin and does not vaporize into the air, although children may be incidentally exposed by ingesting water during bathing.

What are the health effects of 1,4-dioxane?

The possible health effects of 1,4-dioxane depend on the levels in water and the length of time someone is exposed to it. In several laboratory studies, 1,4-dioxane given to rodents over long periods of time have caused liver and nasal cancers. Long-term exposure to 1,4-dioxane has also been linked to adverse effects on the liver and kidney in laboratory tests in rodents. These health effects occurred at exposure levels far above health-based drinking water guidelines. These studies suggest that people exposed to elevated levels of 1,4-dioxane over long periods of time may have an increased risk of certain cancers. In three occupational studies, workers exposed to 1,4-dioxane did not have a greater number of cancers than unexposed individuals. However, these studies were not strong enough to rule out some degree of risk.

What is Massachusetts' health-based guideline for 1,4-dioxane in drinking water supplies?

The MassDEP's Office of Research and Standards (ORS) drinking water guideline for 1,4-dioxane is 0.3 µg/L (micrograms per liter, sometimes described as parts per billion, or ppb). This type of guideline, known as an ORSG, is set to protect against cancer and non-cancer health effects after long-term exposures. USEPA has derived a similar value, using the same data, of 0.35 µg/L. The ORSG and USEPA values are not identical due to difference in mathematical rounding.

What is the basis of the drinking water guideline for 1,4-dioxane?

MassDEP's ORSG for 1,4-dioxane was set using the most current USEPA toxicity information for 1,4-dioxane (please see reference at end of document). The ORSG value of 0.3 µg/L, like that developed by USEPA, is set at a level that protects against possible cancer risks from consuming the drinking water for a lifetime. These values are set at a concentration in drinking water that would increase a person's chance of getting cancer by one-in-a-million if they drank the water daily for a lifetime. USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. EPA 822-S-12-001. Office of Water. Washington, DC). Available at: http://water.epa.gov/drink/standards/hascience.cfm#dw-standards.

If my water sampling results indicate that 1,4-dioxane concentrations were over the ORSG, does this mean that I will get cancer?

No. The ORSG and USEPA guidelines for 1,4-dioxane are cautiously derived to err on the side of protecting public health. The likelihood of getting cancer from exposures to 1,4-dioxane in the water supply depends both on how much 1,4-dioxane is in the water as well as the length of time that the water has been ingested. Estimated risks are based on probabilities and your actual risk could be much lower.

How Will I Know if My Drinking Water has 1,4-dioxane levels above the ORSG?

MassDEP will be involved in communicating this information to people, whether the sources are landfills, hazardous waste sites, or any other location affecting drinking water supplies. With respect to public water supplies the USEPA-led monitoring effort for 1,4-dioxane requires participating Community Public Water Systems to include the information in annual Consumer

Confidence Reports which are delivered to all of their customers. In addition, MassDEP works with public water suppliers to communicate to the public on these issues.

Should I be concerned about breastfeeding my child if I have ingested water containing 1,4-dioxane?

No. 1,4-Dioxane breaks down rapidly in the body and is quickly eliminated, along with its breakdown products, within several days. In addition, 1,4-dioxane is a chemical that does not mix well with fatty liquids such as breast milk so the amount of 1,4-dioxane that would get into breast milk from low-level exposures is insignificant. If you want additional information, you should talk to your health care provider and bring a copy of this fact sheet with you.

Can I drink, cook and make ice with water that contains 1,4-dioxane above the ORSG?

The answer to these questions will depend upon the levels of 1,4-dioxane in your water and must be considered on a case-by-case basis. As a precaution, you may choose to use bottled water (see more on this below) or water from another clean source.

Can I brush my teeth with the water?

Yes. You are unlikely to ingest enough 1,4-dioxane to be of concern.

Can I bathe, shower or wash my hands with the water? Can I bathe my infant in this water?

Yes. 1,4-Dioxane is poorly absorbed through the skin.

Can I use it to wash dishes?
Can I use it to rinse fruits and vegetables?

Yes. The use of water containing 1,4-dioxane for dish washing and rinsing of fruits and vegetables will not result in significant exposures.

Does bottled water contain 1,4-dioxane?

There are no requirements to test for 1,4-dioxane in bottled water in Massachusetts. Consumers should contact the bottler with specific questions about possible 1,4-dioxane content of their water.

Where can I get additional information?

General Information: Contact MassDEP's Office of Research and Standards: 617-292-5998.
If you have concerns about your health status, you should talk to your family doctor and/or an occupational doctor familiar with chemical exposures (see http://www.aoec.org/content/directory_MA.htm). When you meet with them, provide a copy of your 1,4-dioxane sampling results and this factsheet.

References:

US Environmental Protection Agency. Toxicological Review of 1,4-Dioxane (with Inhalation Update) In Support of Summary Information on the Integrated Risk Information System available at http://www.epa.gov/iris/toxreviews/0326tr.pdf