Minnesota Department of Health
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Concerns about potential exposure to 1, 4-Dioxane when showering

MDH reviewed the physical and chemical characteristics of 1, 4-Dioxane. This review confirms that breathing in water while showering at the levels found in the New Brighton drinking water is a relatively minor contributor to overall exposure.

- 1,4-dioxane tends to remain in water because it has a very low Henry's Law Constant (HLC) and dissolves completely in water. This means it won't come out of the water in your shower easily and makes it difficult for drinking water systems to remove it from their supply.
- Only a fraction of the amount of 1,4-dioxane in water will be released and mix with air during showering. Exposures are also limited by the small amount of 1,4-dioxane in the water and the limited amount of water used to shower.

Published information from EPA and ATSDR describe the behavior of 1,4-dioxane in water differently. This difference may lead to confusion. We have asked ATSDR for clarification of their messages.

Henry's Law Constant (HLC)

HLC is a measure of the degree to which a chemical separates between air and water. A chemical with a higher HLC tends to leave the water and move into the air more than another chemical that has a smaller HLC.

Chemicals which do not move very readily into the air from water have smaller HLCs. The 1,4-dioxane HLC of about 0.0000048 atm-m^3/mole (4.8×10^{-6} atm-m^3/mole) is less than the HLC for non-volatile chemicals like pyrene and anthracene.

Chemicals which tend to leave water readily have higher HLCs that range from around 0.01 to 0.001 atm-m^3/mole. Examples of these chemicals are benzene and trichloroethylene. They have HLCs that are greater than the HLC for 1,4-dioxane.

EPA Information:

2015 TSCA Work Plan Chemical Problem Formulation and Initial Assessment for 1,4-Dioxane (http://www.epa.gov/oppt/existingchemicals/pubs/14-Dioxane_final.pdf)

"Due to a high water solubility of > 8.00×10^2 g/L (Yalkowsky and He, 2003) and a low Henry's Law constant of 4.8 × 10-6 atm-m3/mole at 25 °C (Howard, 1990; US EPA, 2009), 1,4-Dioxane is expected to be only slightly volatile from water surfaces and moist soil." (From above document, page 19)

MDH agrees with this characterization.

ATSDR information:

Toxicological Profile or ToxProfile (http://www.atsdr.cdc.gov/toxprofiles/tp187.pdf)
ToxGuide (http://www.atsdr.cdc.gov/toxguides/toxguide-187.pdf)
Public health statement (http://www.atsdr.cdc.gov/ToxProfiles/tp187-c1-b.pdf)
ToxFAQs document (http://www.atsdr.cdc.gov/toxfaqs/tfacts187.pdf)

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The ToxProfile cites the same Henry's Law constant as the EPA assessment but interprets it to indicate that 1,4-dioxane is expected to volatilize at a "moderate rate" from water surfaces. How "moderate rate" is defined in this case isn't clear.

In addition, the ToxGuide includes the statements that "*Inhalation exposure also occurs from 1,4-dioxane released from tap water during bathing and laundering*" and "*Exposure during these activities may be higher than exposure via ingestion of tap water*."

- Although the ToxGuide cites the ToxProfile as its source, these two statements do not exist in the ToxProfile. In fact, the statements only exist in the ToxGuide and are not found in the other ATSDR documents – the ToxProfile, the Public Health Statement, or the ToxFAQs for 1,4-dioxane.
- Although the differences in wording are very slight, the ToxProfile, the Public Health Statement, or the ToxFAQs for 1,4-dioxane only note that inhalation exposure is possible and don't give any indication that it is likely to contribute significantly to exposures.

Contact with questions or for more information:

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