

(Volume I. Emergent chemicals)

1,4-Dioxane

CAS No. 123-91-1

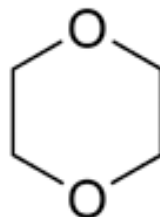
What is 1,4-Dioxane?

1,4-Dioxane is a cyclic ether, and is also known as *p*-dioxane, diethylene ether, diethylene dioxide, and glycol ethylene ether. This compound is highly soluble in water, owing to its molecular structure, shown to the right. The two oxygen atoms make it hydrophilic, and even more miscible than the solvents TCA and TCE it is commonly associated with. It is this considered highly mobile in the subsurface, and only weakly retarded by sorption during transport. It has also been shown to have a negligible BOD, and therefore will not biodegrade extensively in the aquatic environment.

History and Uses: According to the EPA, most of the 1,4-Dioxane produced in the United States was used as a stabilizer for chlorinated solvents. However,

1,4-Dioxane is used in various manufacturing processes and is included in a variety of consumer and commercial products. Uses include paper manufacturing (solvent), paint and varnish remover, deodorants, shampoos, soaps, and cosmetics, in fumigants and pesticides, in pharmaceuticals as a purifying agent, in textile manufacturing, in aircraft deicing fluids, and as an antifreeze additive.

Solvent production in the United States began in the 1920s, with TCE being the preferred solvent through the 1960s. The switch to TCA and concomitant use of 1,4-Dioxane as a stabilizer occurred once issues of occupational exposure to TCE were evident. 1,4-Dioxane was included with TCA in mixtures at 2 to 8% by volume. Solvents were used heavily in electronics manufacturing, metals fabrication, and vapor degreasing processes.



Toxicology: The International Agency for Research on Cancer classifies 1,4-Dioxane as a probable human carcinogen based primarily on evidence in animals. It is also known to damage the liver and kidneys. The primary route of exposure is through the consumption of water contaminated with 1,4-Dioxane. It is also toxic by inhalation.

Regulation: Federal regulations do not yet include an MCL for 1,4-Dioxane. California has a drinking water Notification Level set at 3 ug/L.

Analytical Methodology and Technology

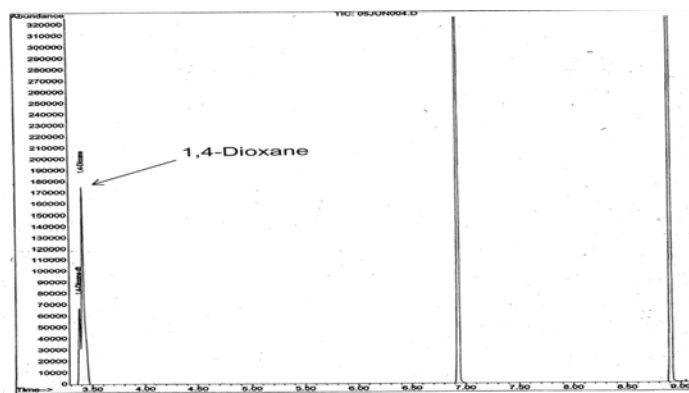
Scope: Analysis of 1,4-Dioxane has traditionally been performed using EPA 8260. However, the high water solubility of 1,4-Dioxane results in poor purging efficiency, and thus laboratories would raise their reporting limits to levels often unacceptable to regulators. Calscience has developed two methods to achieve lower reporting limits for 1,4-Dioxane. Discussed below is the extraction procedure with isotope dilution that may be applied to surface and ground waters.

Procedure: Determination of 1,4-Dioxane is accomplished using EPA 8270 with a modified extraction procedure. A one-liter sample is initially dechlorinated by addition of sodium sulfite. The sample is spiked with a surrogate standard, 1,4-Dioxane-*d*₈ and is then transferred to a continuous liquid-liquid extractor. The sample is extracted at pH 12-13 with methylene chloride, and the extract is concentrated to a final volume of 2-ml. The extract is

analyzed by GC/MS. The concentration of 1,4-Dioxane is measured by relating the MS response of the quantitation ion to the response of the deuterated surrogate standard quantitation ion. Calscience can achieve a reporting limit of 2 ug/L.

Interferences: As a matter of routine, sample extracts with a dark color or high viscosity are subject to Florisil cleanup prior to injection. In this procedure, a glass column is

packed with Florisil and topped with a water adsorbent. Using methylene chloride as the solvent, separation of the 1,4-Dioxane from the interfering matrix is effected. Using the solvent, the 1,4-Dioxane eludes through the column while the Florisil retains the interferences.



Important Information

Molecular Formula C₄H₈O₂

Molecular Weight 88.106

EPA Region IX PRG (tap water) 6.1 μg/L (ppb)

DHS Notification Level 3.00 μg/L (ppb)

DHS Detection Limit for Purposes of Reporting (DLR) 3.00 μg/L (ppb)

Calscience Reporting Limit (RL) 2.00 μg/L (ppb)

Calscience Method Detection Limit (MDL) 0.400 μg/L (ppb)

SAMPLE COLLECTION

- **CONTAINER:** Water samples should be collected into a one-Liter Amber Glass bottle.
- **PRESERVATION:** No preservation is required. Samples should be kept chilled until analysis.
- **HOLDING TIME:** 7 days; 40 days after extraction.

CONTACTS

For further information on laboratory capabilities, please call:

Bob Stearns at (714) 895-5494 or Kim Banks at 626 458-1032 at the Garden Grove Laboratory

Roger Lahr at 619-632-2438 in San Diego, CA

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Ara Aghajanian at 805 544-0486 in the Central Coast