1,4-Dioxane - a new Contaminant of Concern?

Until relatively recently, 1,4-dioxane had received little attention from regulating authorities but the US EPA has listed some critical information summarised below:

"1,4-Dioxane is used as a solvent. Acute (short-term) inhalation exposure to high levels of 1,4-dioxane has caused vertigo, drowsiness, headache, anorexia and irritation of the eyes, nose, throat, and lungs in humans. It may also irritate the skin. Damage to the liver and kidneys has been observed in rats chronically (long-term) exposed in their drinking water. In three epidemiologic studies on workers exposed to 1,4-dioxane, the observed number of cancer cases did not differ from the expected cancer deaths. Tumours have been observed in orally exposed animals. EPA has classified 1,4-dioxane as a Group B2, probable human carcinogen. The one in one million (10^{-6}) risk level for 1,4-dioxane in drinking water is 0.35 µg/L. Hazards Summary from EPA Air Toxics – 1,4-dioxane is a clear colourless liquid with a faint ethereal odour. Flash point 55°F (12.8°C). Slightly denser than water and soluble in water. Vapours heavier than air. Susceptible to autoxidation to form peroxides."

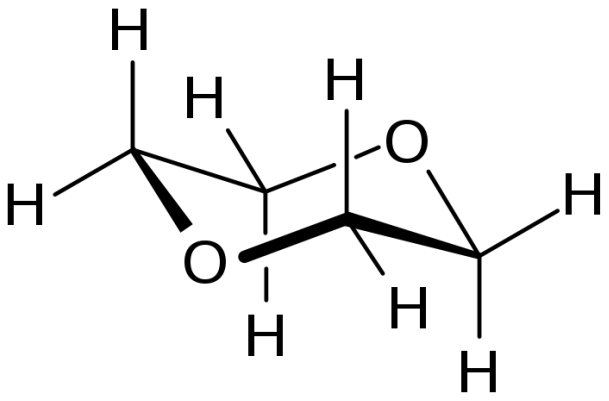

Figure 1: 1,4-Dioxane Structure

By Dschanz (Own work (drawn with BKChem)), via Wikimedia Commons

The investigations into 1,4-dioxane contamination at legacy sites has drawn the label of 1,4-dioxane as an "emerging contaminant or contaminant of concern". Primarily due to the use of 1,4-dioxane as a solvent stabiliser for chlorinated solvents such as trichloroethane (TCA), previously closed dry-cleaning sites are being reinvestigated for this volatile, water miscible, toxic contaminant. Although 1,4-dioxane is listed as a volatile compound having a boiling point of 101°C it is not well suited to traditional VOC analyses such as purge & trap GC-MS and because of its high polar nature makes it difficult to extract with traditional liquid-liquid partition techniques. This presents some challenges for the analytical chemist to achieve the sub-ppb limits of reporting required by regulatory authorities.

Our Capabilities

Eurofins has adopted US EPA Method 522 for analysing for 1,4-dioxane in matrices potentially impacted including drinking water, groundwater, wastewater, soil, and sediment which has been designed to meet the data quality objectives of your project and meet regulatory requirements. US EPA Method 522 employs isotope dilution high resolution gas chromatography-mass spectrometry (HRGC-MS) using a 1,4-dioxane-d_8 surrogate together with solid-phase extraction and THF-d_8 is used as the internal standard providing the most accurate and direct assurance of analytical quality.

	Water	Soil/Sediments
Limit of Reporting	**0.05 µg/L**	**0.01 mg/kg**
Container	**200mL amber glass**	**250mL glass jar with Teflon lined cap.**
Preservation*	**Sodium bisulfate, <6°C**	**<6°C**
Holding Time	**28 days**	**28 days**
NATA	**Yes**	**Yes**

* for chlorinated drinking water the addition of sodium sulfite is required.

1,4-dioxane may migrate rapidly into the groundwater from contaminated soil, ahead of other contaminants and does not volatilise rapidly from surface water bodies. Migration to groundwater is weakly retarded by sorption of 1,4-dioxane to soil particles; it is expected to move rapidly from soil to groundwater. 1,4-dioxane is relatively resistant to biodegradation in water and soil. Exposure may occur through inhalation of vapours, ingestion of contaminated food and water or dermal contact.

Eurofins | mgt Expertise

If you would like to discuss logistical details of your 1,4-dioxane analyses then please contact your local Analytical Service Manager or one of our Business Development team listed below. Technical support can be provided by contacting Dr. Bob Symons.

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