1,4-Dioxane: Drinking Water Practical Quantitation Levels

Zhihua (Tina) Fan, Ph.D.

Chair, Testing Subcommittee

New Jersey Drinking Water Quality Institute

Virtual Meeting

September 30, 2020

USGS Water Science Center

Lawrenceville, NJ

Procedure for Describing Process for Development of an Analytical Interim Practical Quantitation Levels (PQL)

1. Basis for PQL 1,4-Dioxane appears as a listed parameter in a published USEPA Method 522.

2. The published detection level (DL) range for water is 0.020 μg/L to 0.026 μg/L depending on the absorbent cartridge used to isolate this compound.

3. Using the Department's standard practice for calculating a PQL this DL is multiplied by a factor of five (5), which results in a PQL value of 0.1 ppb.
   Interim PQL: 0.1 ppb (0.1 ug/L)
   Human Health Criterion for ground water – 0.4 μg/L

USEPA Method 522

Determination of 1,4-dioxane in drinking water by solid phase extraction (SPE) and gas chromatography/mass spectrometry (GC/MS) with selected ion monitoring (SIM) (2008)

- Applicable Matrix: Drinking water, reagent water, finished ground and surface water.
- Detection Limit (DL) : 0.020 - 0.026 µg/L
- *Lowest Concentration Minimum Reporting Level (LCMRL): 0.036 ug/L and 0.047 ug/L have been determined in reagent water. The single laboratory LCMRL is the lowest true concentration for which the future recovery is predicted to fall, with high confidence (99%), between 50 and 150% recovery*

LCMRL is the lowest true concentration for which the future recovery is predicted to fall with high confidence (99%) between 50 and 150% recovery.

Highlights of USEPA Method 541

Determination of 1-Butanol, 1,4-Dioxane, 2-Methoxyethanol and 2-Propen-1-ol in Drinking Water by Solid Phase Extraction (SPE) and Gas Chromatography/Mass Spectrometry (GC/MS) (2015)

- Analytical Instrument: GC/MS with SIM is used to provide selectivity for the method analytes.
- Applicable Matrix: Finished drinking water, reagent water, finished ground and surface water.
- Required technical skills: Analysts experienced in SPE, GCMS and advanced data analysis.

USEPA 541 : Precision and Accuracy Data for Reagent Water using Waters AC-2 SPE cartridge[1]

Analyte	Fortification (μg/L)	Mean % R[2] (n = 7)	% RSD[3]	Fortification (μg/L)	Mean % R[2] (n = 5)	% RSD[3]
1,4-dioxane	0.40	102	3.9	8.0	96.8	2.0
2-propene-1-ol	2.0	88.1	4.4	40	90.8	1.1
1-butanol	2.0	97.0	2.6	40	92.2	1.8
2-methoxyethanol	2.0	93.3	3.0	40	92.4	1.6
2-propene-1-ol-*d6* (surrogate)	10	92.6	3.3	10	92.2	0.94
1-butanol-*d10* (surrogate)	10	95.5	2.3	10	92.7	1.1

[1]Adopted from USEPA Method 541 SOP
[2]R = percent recovery
[3]RSD = percent relative standard deviation

METHOD 541: LCMRL[1] Results for the Waters AC-2 SPE Format[2]

Analyte	LCMRL Fortification Levels (µg/L)	Calculated LCMRL (µg/L)
1,4-dioxane	0.0, 0.040, 0.070, 0.10, 0.20, 0.30, 0.40, 0.50	0.074
2-propen-1-ol	0.0, 0.20, 0.35, 0.50, 1.0, 1.5, 2.0, 2.5	0.30
1-butanol	0.0, 0.20, 0.35, 0.50, 1.0, 1.5, 2.0, 2.5	0.44
2-methoxy-ethanol	0.0, 0.20, 0.35, 0.50, 1.5, 1.0, 2.0, 2.5	0.37

[1]LCMRL = Lowest concentration minimum reporting level

[1]Adopted from USEPA Method 541 SOP

Critical Comments and Proposed Recommendations

- Method USEPA 541 was not used in the UCMR3 national survey and therefore does not have interlaboratory data on a national scale to determine comparability with USEPA method 522 used in UCMR3.
- Performance data published in method 541 indicates equivalent sensitivity for 1,4 Dioxane to be recommended by the testing subcommittee without the interlaboratory data to evaluate the occurrence of 1,4 Dioxane in drinking water.
- Method 522 is currently listed as a one parameter method for 1,4 Dioxane, and discussion with a lead USEPA subcontractor UCMR3 lab indicated that the laboratory analysts did not consider addition SIM programming to include the additional oxidation byproducts of 1,4 dioxane.

Acknowledgement

- Testing Subcommittee
  - Leslie Brunell
  - David Pranitis

- Technical Support
  - Lee Lippincott
  - Jhindan Mukherjee
  - C. David Riker

Thank you for your attention!

Questions/Comments

Tina Fan, Ph.D.

New Jersey Department of Health, Public Health and Environmental Laboratories

tina.fan@doh.nj.gov