What You Need to Know about 1,4-Dioxane Analysis

Until recently, 1,4-dioxane has received little attention from regulation agencies. This compound is a frequent contaminant of concern sites contaminated with chlorinated compounds, due to its widespread use as a stabilizer for chlorinated solvents. No federal maximum contaminant level in drinking water has been established, however some state agencies have set limits as low as 0.25 µg/L (i.e., New Hampshire).

Analytical Methods

There are three methods typically used for the analysis and accurate quantitation of 1,4-dioxane and there are pros and cons to each. Depending on your goals, you might choose either SW-846 Method 8260 SIM with isotope dilution, SW-846 Method 8270 SIM with isotope dilution, or EPA Method 522 SIM.

Method 8260 SIM – The reporting limit (RL) is typically higher due to the poor purge efficiency for 1,4-dioxane. Reported low concentrations of 1,4-dioxane by this method are questionable, at best. This method is best suited for high concentrations.

Method 8270 SIM –This method can achieve lower RLs because this is an extraction vs. a purge. It is a better choice than Method 8260 for low concentrations of 1,4-dioxane, but can be subject to loss during the extraction and concentration steps.

Method 522 SIM - This is a drinking water method specific for the analysis of 1,4-dioxane and is Florida's Department of Health method of choice. It is not subject to the purge and extraction issues that Method 8260 and Method 8270 have, which allows for achieving low RLs. At this time, there are fewer laboratories certified for this method than for Methods 8260 and 8270.

1, 4-Dioxane is completely miscible in water, which causes poor purging and resulting in high detection limits using standard volatile methods. In addition, standard methods do not require the use of 1, 4- dioxane-d_8 as a surrogate to monitor and correct for purge inefficiencies. 1,4-Dioxane-d_8 is a man-made chemical in which all eight hydrogens are replaced with deuterium. The resulting labeled compound responds to the analytical system in the same manner as the unlabeled native compound, 1,4-dioxane. This facilitates accurate quantitation of 1,4-dioxane

because the concentration of the contaminant can be corrected for the percent recovery (%R) of the labeled compound, thereby adjusting it to reflect how well it was recovered by the method. This mode of quantitative analysis is called isotope dilution and is used to improve the accuracy of how representative the reported concentration of the contaminant compound is of what is really present at the site.

Considerations

There are other considerations that will influence the appropriate method for your project. These include:

1) Concentrations of other site compounds. Are concentrations of other site contaminants so high that a low RL for 1,4-dioxane is not necessary?
2) Project-specific clean up criteria.
3) Previously approved site-specific documents defining an analytical method.

Communication with the laboratory is vital when selecting your method. If Method 8260 or Method 8270 are options, confirm with the laboratory that they are using 1,4-dioxane-d_8 as a surrogate and performing isotope dilution methodology. If isotope dilution is not performed, the correction based on the recovery of the 1,4-dioxane-d_8 can be performed by the data user. The laboratory RL, not the method detection limit (MDL), must meet the site clean-up criteria. The MDL is a statistically generated number and is not supported by the reported data. Use caution when comparing historical 1,4-dioxane data generated by one method with data generated using other techniques, because as they may not readily compare due to the limitations described above.

References

United States Environmental Protection Agency, Office of Solid Waste and Emergency Response (5106P), EPA 505-F-14-011, November 2017.

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