REGION 5
CHICAGO, IL 60604

May 20, 2024

MEMORANDUM

SUBJECT: DRAS 4 Frequently Asked Question (FAQ): Should sample analytical (total) concentrations be entered as "wet weight" or "dry weight"?

FROM: Christopher Lambesis, Environmental Scientist, EPA R5 LCARD

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TO: EPA National Delisting Workgroup

Introduction

The RCRA regulations include a petition process for evaluating whether a listed waste generated by a specific process at a particular facility warrants removal from the list of hazardous wastes (See 40 CFR §260.22). This process includes waste analysis and an evaluation of the potential risk from non-hazardous disposal of the waste. EPA has published a modeling tool (the Delisting Risk Assessment Software – or DRAS) useful in this evaluation that requires the input of concentrations of constituents of concern (COCs) in the waste. EPA has been asked by prospective delisting petitioners, State Agencies and EPA regional staff who evaluate delistings, if the *total* concentration input to DRAS for non-liquid waste to be disposed in a Subtitle D (non-hazardous) landfill is on a *dry-weight* basis or on an *as-is*, *as-received* basis (sometimes referred to as *wet-weight*). As discussed below, the correct input should be on a dry-weight basis.

Uses of Dry-Weight and Wet-Weight Sample Results

Delisting Petitioners submit laboratory analytical reports stating COC concentrations, analytical reporting limits and associated quality control information as supporting documentation with hazardous waste delisting petition risk assessments. These reports typically specify whether analyses for solid samples are expressed as COC concentrations in "wet weight" (meaning in the waste "as is")

or by dry weight (meaning in a concentration without moisture content). Analytical results based on dry weight can be typically converted to wet weight by multiplying the dry-weight concentration by the value of one minus the fraction moisture content (e.g., see SW-846 3010D 12.2, 6020A 12.1).
The concentration of a given COC can vary widely with changes in the moisture content of the sampled media. In cases of soils or solid wastes, the COC concentrations can change significantly if a sample is collected just after a rainfall versus after several days of dry weather, or if the media is dewatered with a filter press, or other actions. The extra moisture content can dilute the dry concentration of COCs.

In making environmental decisions, the COC concentration in media can trigger regulatory determinations, exceed clean-up goals, or affect risk assessments. When performing a risk assessment, the wet- or dry-weight input COC concentrations of the sampled media should match the form of the risk assessment's fate and transport models used to calculate COC concentrations in exposure media.

EPA's guidance *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW–846)* Method 8000D addresses this issue in section 11.10.5 Moisture-corrected reporting:

> Results for solid samples may be reported on the basis of wet-weight (as received) or dry-weight (moisture-corrected) sample concentration. There are merits to either approach; however, some regulatory limits associated with solid wastes and solid samples are based on the form of the waste as generated, which rarely involves oven-dry solids. As a result, there is no default preference for one form or the other. The choice of "as received" or moisture-corrected reporting is always a project specific decision that *must be based on knowledge of intended use of the data.* [emphasis added]

The Intended Use of the COC Concentrations in DRAS

The intended use of the analytical results is to provide the DRAS model with COC concentrations in the waste so that the risk model can estimate release, transport, and exposure for the surface pathway. According to the *Delisting Technical Support Document* (DTSD)[1], for a solid waste landfill, the surface pathway includes both air emissions of particles and volatiles as well as runoff from waste exposed at the surface of the landfill. All these elements of the model operate on a dry-weight basis and therefore require dry-weight concentrations.

<u>Air Emissions Modeling</u>

Section 2.3.1.1 of the DTSD estimates particulate emissions from three different mechanisms. The first, Wind Erosion Emissions, expressed primarily in Equation 2-9, is taken from a 1985 EPA model for

[1] *RCRA Delisting Technical Support Document,* U.S. EPA Office Solid Waste, Chicago, IL, July 31, 2020, https://www.epa.gov/hw/technical-support-document-hazardous-waste-delisting-risk-assessment-software-dras

particulate emissions from surface contamination sites[2]. The relationship used is for estimating soil wind erosion from surfaces with unlimited erosion potential. EPA 1985 states that "[b]ecause highly erodible soils do not readily retain moisture, no moisture-related parameter is included in the equation."

Particulate emissions from vehicles driving over the waste in the landfill are estimated by DRAS (DTSD Equation 2-17) using a model for particulate emissions from unpaved roads from the EPA 1985 Fourth Edition of the AP-42 Series of Emission Factors[3]. The AP-42 states "[u]npaved roads have a hard, generally nonporous surface that usually dries quickly after a rainfall." Reductions in emissions due to rain adding moisture to the unpaved road is estimated by eliminating emissions on days with rain (assumed to be 90 days per year), not by adding moisture to the model equation. Thus, emissions are estimated as a dry-material mechanism.

Particulate emissions from waste loading and unloading are estimated by DRAS (DTSD Equation 2-21) using a model for loading of aggregate onto storage piles in the EPA 1985 Fourth Edition of the AP-42 Series of Emission Factors. The aggregate is modeled as a dry material with minimal moisture content.

Section 2.3.2.1 of the DTSD (Equation 2-33) estimates volatile emissions from a landfill using Shen's modification of Farmer's Equation developed in 1984 by the EPA Office of Air Quality Planning and Standards. Moisture of the surface cover through which volatiles are to diffuse was assumed to be zero to maximize emissions. In the DRAS mismanagement scenario, 30 days of waste left uncovered, the surface cover would also comprise the delisted waste material.

Calculation of Waste Constituent Concentrations in Surface Water (Universal Soil Loss Equation)

Section 2.3.3 of the DTSD estimates erosion of the waste material from the surface of a solid waste landfill using "the universal soil loss equation (USLE) (Wischmeier and Smith 1978[4]) to compute long-term soil and waste erosion from a landfill in which delisted waste has been disposed." DTSD Equation 2-48, the USLE, has no component for the pre-erosion moisture content of the eroded material. DTSD Equations 2-49, 2-50, and 2-51 relate the eroded soil and waste (here referred to as an eroded sediment) to delivery of eroded sediment to surface water. None of these equations include a term for the pre-erosion moisture content of the eroded material. (Dr. Robert Wells of the USDA Watershed Physical Processes Research Unit confirmed in a phone conversation with EPA that the calculations and erosion estimates derived from the USLE are made on a dry-weight basis[5].)

Conclusion

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[2] *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites*, Cowherd, C., et al, Midwest Research Institute, Kansas City, MO, for U.S. EPA Office of Health and Environmental Assessment and Office of Research and Development, February 1985.

[3] *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*, *AP-42, Fourth Edition*, Office of Air and Radiation and Office of Air Quality Planning and Standards, U.S. EPA, Research Triangle Park, NC, September 1985.

[4] *Predicting Rainfall-Erosion Losses from Cropland East of the Rocky Mountains*, Wischmeier, W.H. and D.D. Smith, USDA Handbook, No. 282, Agricultural Research Service, 1978.

[5] Phone conversation, Ramaly, T. EPA with Wells, R., Ph.D., USDA, April 4, 2024.

Given that all the release models for emissions and runoff from the surface of a solid waste landfill for DRAS use dry material or are based on dry-sediment delivery, the appropriate concentrations to model these release scenarios are those determined on a dry-weight basis.