NOVEMBER 2024

RECOMMENDATIONS FOR SIEVING SOLID MEDIA SAMPLES AT SUPERFUND SITES FOR ASSESSMENT OF INCIDENTAL INGESTION EXPOSURE IN HUMAN HEALTH RISK ASSESSMENT

OVERVIEW

The purpose of this document is to extend the technical guidance produced by the Technical Review Workgroup for Metals and Asbestos (TRW) Lead Committee for lead-contaminated sites (U.S. EPA, 2016) to all sites where contaminants[1] in solid media (soil, sediment or dust) may be contacted by human receptors and exposure includes incidental ingestion[2]. Particle size is an important determinant of dermal adherence which drives ingestion of solid media[3]. Sieving solid media to the fine fraction (<150 µm) increases confidence in risk calculations for incidental ingestion exposure to contaminants in solid media because of the stronger relationship with dermal adherence relative to larger particle size fraction. For human health risk assessments (HHRAs) and risk evaluations where incidental ingestion of solid media is a complete exposure pathway, the contaminant concentration is representative of dermal adherence and subsequent incidental ingestion applies to all non-volatile contaminants (excepting asbestos and radiological compounds) and select semi-volatiles (Ruby and Lowney, 2012; Yamamoto et al., 2006). Site-specific HHRA requires that solid media samples accurately represent incidentally ingested material. For human health risk assessment, sieving solid media samples[4] to the particle size fraction that best represents the fraction that adheres to hands improves the representativeness of risk calculations and subsequent management decisions.

This document provides the technical basis for recommending specific particle size fractions for analysis of select contaminants in solid media contaminated sites for human health risk assessment. This document is for human health risk assessors and others who are involved in designing sampling plans to determine the concentration of contaminants[1] in solid media samples that the conceptual site model indicates will be used to derive exposure point concentrations for use in HHRAs.

BACKGROUND

Incidental ingestion is the primary pathway for exposure to non-volatile contaminants in solid media (e.g., soil, dust and sediment) and is governed by dermal adherence (Ruby and Lowney, 2012; Lanphear et al. 2002; Lanphear et al. 1998; Succop et al. 1998; Landrigan et al. 1975).[5] Particle size, an important determinant of dermal adherence, may be, depending on the source of contamination, inversely

[1] Sieving of solid media is applicable to metals, metalloids, PAHs, dioxins, furans, and other contaminants in solid media. Other semi-volatile compounds (SVOCs), volatile organic compounds (VOCs), asbestos, and radiological compounds (MARSSIM, 2002) are excluded from sieving due to potential effects of physical sample processing on contaminant concentrations.

[2] Note that these sieving recommendations do not necessarily apply to ecological receptors.

[3] Note that these sieving recommendations do not apply to inhalation exposure scenarios.

[4] Solid media includes dust, soil, sand, and wet soil/sediment.

[5] It is known that some individuals deliberately ingest soil (pica) and that these individuals may have soil ingestion rates far higher than the typical ingestion levels used in most U.S. EPA risk assessments. Pica exposure is generally not assessed in Superfund lead risk assessments.

associated with contaminant concentration, mobility, and bioavailability (Beamer et al., 2012; Madrid et al., 2008; ATSDR, 2007; Madrid et al., 2002; Lanphear et al., 2002; Manton et al., 2000; Lanphear et al., 1998; Layton and Beamer, 2009; Sheppard and Evenden, 1992, 1994; Sterling et al., 1998). As such, reliable data for the particle size fraction that is most likely to adhere to hands and for the concentration of contaminants found in that particle size can improve the accuracy of exposure and risk calculations in HHRAs and risk evaluations.

RECOMMENDATIONS FOR SIEVING SOLID MEDIA AT CONTAMINATED SITES

Site-specific HHRA requires that solid media samples accurately represent incidentally ingested material; sieving solid media samples to the particle size fraction that best represents dermal adherence, improves the confidence in risk calculations and subsequent management decisions for contaminants other than VOCs, asbestos, and radiological compounds.

The Office of Superfund Remediation and Technology Innovation (OSRTI) is recommending sieving dry (e.g., less than [<] 10 percent [%] moisture)[6] soil samples through a No. 10 (2.0 mm) sieve (ASTM, 1999) to remove any large debris (*e.g.*, sticks, stones; U.S. EPA, 2000)[7] prior to analyzing for soil contaminants.

The resulting "total" sample (defined as the total solid media that passes through a 2 mm sieve) should be weighed and sieved through a No. 100 W.S. Tyler® sieve[8] or equivalent to identify the "coarse" (>150 micrometer [µm]) and the "fine" (<150 µm) fractions of the sample. The fine fraction (<150 µm) has increased potential for incidental ingestion based on stronger relative dermal adherence, an increased likelihood to accumulate in the indoor environment (through deposition of wind-blown soil and/or transport track-in of soil on clothes, shoes, pets, toys, and other objects), and the possibility of enrichment of contaminants in this smaller particle size fraction. Thus, the fine fraction (<150 µm) is generally recommended for use in the assessment of human health risks for soil and dust exposures to contaminants (excepting select SVOCs, VOCs, asbestos, and radiological compounds).

Sieving soil samples collected from CERCLA sites to <150 µm is also consistent with U.S. EPA recommendations for particulate sampling under the Resource Conservation and Recovery Act (RCRA) (U.S. EPA, 2016). In addition, particulate sampling theory recognizes that sampling errors are reduced when smaller particles are sampled (Barcan et al., 1998; Gy, 1998, 1992, 1982).

On a site-specific basis, it may be appropriate for risk management decisions to consider the benefits of obtaining information on other particle size fractions (*e.g.*, <250, <125, <63, <50 µm) to better relate ingestible size fractions with site history or site-specific conditions.[9] For example, it may be appropriate to consider larger particle size fractions (i.e., <250 µm) at sites where wet soil (or sediment) contact

[6] Sample preparation prior to sieving (e.g., drying and disaggregation of large clumps) should be appropriate for the site and contaminants of potential concern in solid media.

[7] Breaking clumps of soil by hand is acceptable; grinding or milling samples to achieve the particle size fraction is not recommended.

[8] See ASTM E11 and ISO 565 for more information. Depending on the sieve manufacturer, the particle size fraction may be <150 µm or <149 µm (these are considered equivalent),

[9] Representative site-specific data are essential for developing a risk assessment (as well as cleanup goals) that reflect the current or potential future site conditions.

and subsequent incidental ingestion may be expected (larger particles can adhere to hands when wet [U.S. EPA, 2016; Kissel et al., 1996; Rudy and Lowney, 2012]). Alternatively, smaller particle size fractions may also be informative for certain sites. Regional risk assessors should be contacted to discuss site-specific conditions that may warrant consideration of alternative particle size fractions consistent with Data Quality Objectives (USEPA, 2006) for sampling at the site.

Recognizing the importance of particle size as it relates to dermal adherence of solid media, consequent incidental ingestion, and variance in contaminant levels in solid media (Ruby and Lowney, 2012; Beamer et al., 2012; Bergstrom et al., 2011; Siciliano et al., 2009; Yamamoto et al., 2006), these recommendations apply to Superfund site HHRAs and risk evaluations where non-volatile contaminants[1] occur in solid media and contact via incidental ingestion is expected.

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