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Standard Guide for Sampling Radioactive Tank Waste[1]

This standard is issued under the fixed designation C1751; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide addresses techniques used to obtain samples from tanks containing high-level radioactive waste created during the reprocessing of spent nuclear fuels. Guidance on selecting appropriate sampling devices for waste covered by the Resource Conservation and Recovery Act (RCRA) is also provided by the United States Environmental Protection Agency (EPA) (**1**).[2] Vapor sampling of the head-space is not included in this guide because it does not significantly affect slurry retrieval, pipeline transport, plugging, or mixing.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D1129 Terminology Relating to Water

3. Terminology

3.1 *Definitions*—For definitions of terms used in this method, refer to Terminology D1129.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *forced evaporation, n*—intentional concentration of a waste solution using heat or vacuum, or both, primarily to remove water or other solvents.

3.2.2 *pH modified, n*—a description of a solution where the pH is adjusted with either an acid or base material to achieve a desired pH level to minimize tank corrosion.

3.2.3 *soft sludge, n*—a sludge with a low viscosity where minimal sampling device pressure could be used to penetrate the sludge layer.

3.2.4 *sparge, n*—a process of delivering a chemically inert gas through fluids to displace materials for the purpose of mixing.

3.3 *Acronyms:*

3.3.1 *EREE*—Extended Reach End-Effector

3.3.2 *HAST*—Highly-Active Storage Tanks

3.3.3 *LDUAs*—Light-Duty Utility Arms

3.3.4 *NPH*—Normal Paraffin Hydrocarbons

3.3.5 *ORNL*—Oak Ridge National Laboratory

3.3.6 *PTFE*—Polytetrafluoroethylene

3.3.7 *PVC*—Polyvinyl Chloride

3.3.8 *RFD*—Reverse-Flow Diverter

4. Significance and Use

4.1 Obtaining samples of high-level waste created during the reprocessing of spent nuclear fuels presents unique challenges. Generally, high-level waste is stored in tanks with limited access to decrease the potential for radiation exposure to personnel. Samples must be obtained remotely because of the high radiation dose from the bulk material and the samples, samples require shielding for handling, transport, and storage. The quantity of sample that can be obtained and transported is small due to the hazardous nature of the samples as well as their high radiation dose.

4.2 Many high-level wastes have been treated to remove strontium (Sr) or cesium (Cs), or both, have undergone liquid volume reductions through pumping and forced evaporation or have been pH modified, or both, to decrease corrosion of the tanks. These processes, as well as waste streams added from multiple process plant operations, often resulted in

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[2] The boldface numbers in parentheses refer to a list of references at the end of this standard.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

precipitation, and produced multiphase wastes that are heterogeneous. Evaporation of water from waste with significant dissolved salts concentrations has occurred in some tanks due to the high heat load associated with the high-level waste and by pumping and intentional evaporative processing, resulting in the formation of a saltcake or crusts, or both. Organic layers exist in some waste tanks, creating additional heterogeneity in the wastes.

4.3 Many of the sampling systems have limitations including the ability to sample varying depths in the tank and the depth of sampling. Sampling in Hanford tanks is constrained by riser diameter, riser location and riser availability.

4.4 Due to these extraordinary challenges, substantial effort in research and development has been expended to develop techniques to provide grab samples of the contents of the high-level waste tanks. A summary of the primary techniques used to obtain samples from high-level waste tanks is provided in Table 1. These techniques will be summarized in this guideline with the assumption that the tank headspace is adequately ventilated during sampling.

TABLE 1 High-Level Waste Tank Sampling Methods

Technique	Material Type			Notes
	Solid	Slurry	Liquid	
HAST in-tank needle orifice			X	Orifice as part of Reverse-Flow Diverter (RFD)
Bottle on a String		X	X	Dip sample
Vacuum Pump		X	X	
Auger	X	X		Only high viscosity slurries
Sample Cup	X	X		Manual system used at Savannah River Site to obtain salt-cake samples and hard sludges that don't slump.
Core Drilling: Rotary Mode (Hanford Sampler)	X	X		Hard sludges and salt-cake.
Core Drilling: Push Mode (ORNL Soft Sludge Sampler)		X	X	Liquid or soft sludges.
Off-Riser Sampling System (ORSS crawler)	X	X		Used to collect sludge samples to support tank closure at Hanford.
Cylinder with retractable nose cone		X	X	Used at Savannah River Site for soft sludges and liquids.
Robotic Arm	X	X	X	Material type captured is dependent upon the end-effector.
Clamshell Sampler	X	X		Used to collect solids samples at Hanford
Fingertrap Sampler	X	X		Used to collect solids samples at Hanford
Drag Sampler	X	X		Used to collect sludge samples to support tank closure at Hanford.
Hydraulic Mining	X	X	X	
Hydraulic Scoop	X	X	X	
Sample Thief (Bacon Bomb)			X	