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Standard Guide for Recovery of Aqueous Cyanides by Extraction from Mine Rock and Soil After Remediation of Process Releases¹

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1. Scope

1.1 This guide is applicable for the collection, extraction and preservation of extracts from mine rock and soil samples ~~after remediation of cyanide process releases~~ for the analysis of cyanide in the extracts. Responsibilities of field sampling personnel and the laboratory are indicated.

1.2 The sampling, preservation and extraction procedures described in this practice are recommended for the analysis of total cyanide, available cyanide, weak acid dissociable cyanide, and free cyanide by Test Methods D2036, D4282, D4374, D6888, D6994, D7237, and D7284. The information supplied in this practice can also be applied to other analytical methods for cyanide, for example, US EPA Method 335.4.

1.3 The values stated in SI units are to be regarded as standard.

1.4 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*² ~~D75 Practice for Sampling Aggregates~~

D1129 Terminology Relating to Water

D1193 Specification for Reagent Water

D1293 Test Methods for pH of Water

D2036 Test Methods for Cyanides in Water

D3694 Practices for Preparation of Sample Containers and for Preservation of Organic Constituents

D3856 Guide for Good Laboratory Practices in Laboratories Engaged in Sampling and Analysis of Water

D4282 Test Method for Determination of Free Cyanide in Water and Wastewater by Microdiffusion

D4374 Test Methods for Cyanides in Water Automated Methods for Total Cyanide, Weak Acid Dissociable Cyanide, and Thiocyanate

D4840 Guide for Sample Chain-of-Custody Procedures ~~D5847 Practice for Writing Quality Control Specifications for Standard Test Methods for Water Analysis~~

D4841 Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents

D5847 Practice for Writing Quality Control Specifications for Standard Test Methods for Water Analysis

D6888 Test Method for Available Cyanide with Ligand Displacement and Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection

D6994 Test Method for Determination of Metal Cyanide Complexes in Wastewater, Surface Water, Groundwater and Drinking Water Using Anion Exchange Chromatography with UV Detection

D6696 Guide for Understanding Cyanide Species

D7237 Test Method for Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection

D7284 Test Method for Total Cyanide in Water by Micro Distillation followed by Flow Injection Analysis with Gas Diffusion Separation and Amperometric Detection

D7365 Practice for Sampling, Preservation and Mitigating Interferences in Water Samples for Analysis of Cyanide

¹ This practice is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.06 on Methods for Analysis for Organic Substances in Water.

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² 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.



~~D7511 Test Method for Total Cyanide by Segmented Flow Injection Analysis, In-Line Ultraviolet Digestion and Amperometric Detection~~

~~E877 Practice for Sampling and Sample Preparation of Iron Ores and Related Materials for Determination of Chemical Composition~~ Test Method for Total Cyanide by Segmented Flow Injection Analysis, In-Line Ultraviolet Digestion and Amperometric Detection

2.2 U.S. EPA Methods:³

EPA OIA-1677 Available Cyanide in Water

EPA Method 335.2 Cyanide, Total (Titrimetric; Spectrophotometric)

EPA Method 335.4 Determination of Total Cyanide by Semi-Automated Colorimetry

3. Terminology

3.1 *Definitions*: For definitions of terms used in this practice, refer to Terminology D1129 and Guide D6696.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *refrigeration* mine rock, *n*—~~storing the sample between its freezing point and 6°C.~~—ore, waste rock or overburden excavated in order to construct an ore-processing site, or recover metals or minerals during mining operations; or coarse processed ore such as heap-leach spoils.

3.2.2 *mine rock* nominal size, *n*—ore, waste rock or overburden excavated in order to construct an ore-processing site, or recover metals or minerals during mining operations; or coarse processed ore such as heap-leach spoils. —*n*—~~in sampling, for a the opening of the screen of the standard series, the opening that would pass 95 % of a representative sample~~

3.2.3 *refrigeration*, *n*—storing the sample between its freezing point and 6°C.

4. Summary of Guide

4.1 Samples are collected in appropriate containers at the ~~remediation~~sampling site, refrigerated and transported to the laboratory where they are weighed, sub-sampled, the moisture is determined and cyanides are extracted prior to analysis. Results of the analysis of the extract are applied to the original solid sample to determine the apparent concentration of cyanides dissolved in water present in the solids as the result of the process release.

5. Significance and Use

5.1 This practice is intended as a means for obtaining an extract from mine rock and soil samples ~~to verify the effectiveness of measure cyanide release remediation concentrations.~~ Cyanide is analyzed in mine rock and soil extracts ~~after remediation for measurement of process spills, to demonstrate regulatory compliance; cyanide concentration;~~ however, improper sample collection and extraction can result in significant positive or negative bias, potentially resulting in unnecessary permit violations or undetected cyanide releases into the environment.

5.2 This practice is designed to mobilize aqueous cyanides present in the solids, so that the resulting extract can be used to assess leachate that could potentially be produced from remediated mine rock or soil in the field.

5.3 This practice is not intended to simulate actual site leaching conditions.

5.4 This practice produces extracts that are amenable to the determination of minor (trace) constituents. When minor constituents are being determined, it is especially important that precautions be taken in sample preservation, storage and handling to avoid possible contamination of the extracts.

5.5 This practice uses a comparative test method and is intended for use as a routine method for monitoring remediated mine rock and soils after process releases and remediation. It is assumed that all who use this practice will be trained analysts capable of performing it skillfully and safely. It is expected that work will be performed in a properly equipped laboratory applying appropriate quality control practices such as those described in Guide D3856.

6. Interferences

6.1 Many interferences are known for the analysis of cyanide and could effect the results of the analysis of extracts produced using this practice. Refer to Practice D7365 for proper handling of the extracts during sampling, mitigation of interferences and preservation prior to cyanide analysis.

6.2 Unless otherwise specified, samples must be extracted within 72 hours and the extracts must be analyzed within 14 days; however, it is recommended to estimate the actual holding time for each new sample matrix as described in Practice D4841. Certain sample matrices may require immediate analysis to avoid cyanide degradation due to interferences. A holding time study is required if there is evidence that cyanide degradation occurs from interferences which would cause the holding time to be less than specified in this practice or Practice D7365. Potential interferences for cyanide analytical methods are shown in Table 1.

7. Apparatus

7.1 *Agitation Equipment*, of any type that rotates the extraction vessel in an end-over-end fashion at a rate of 30 ± 2 r/min such that the axis of rotation is horizontal and it passes through the center of the bottle (see Fig. 1).

³ Available from United States Environmental Protection Agency (EPA), Ariel Rios Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.gov>.