Designation: D4793 – 09 (Reapproved 2023)

Standard Test Method for Sequential Batch Extraction of Waste with Water[1]

This standard is issued under the fixed designation D4793; 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 test method is a procedure for the sequential leaching of a waste containing at least five percent solids to generate solutions to be used to determine the constituents leached under the specified testing conditions.

1.2 This test method calls for the shaking of a known weight of waste with water of a specified purity and the separation of the aqueous phase for analysis. The procedure is conducted ten times in sequence on the same sample of waste and generates ten aqueous solutions.

1.3 This test method is intended to describe the procedure for performing sequential batch extractions only. It does not describe all types of sampling and analytical requirements that may be associated with its application.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *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:*[2]

D75/D75M Practice for Sampling Aggregates

D420 Guide for Site Characterization for Engineering Design and Construction Purposes

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1129 Terminology Relating to Water

D1193 Specification for Reagent Water

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2234/D2234M Practice for Collection of a Gross Sample of Coal

D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water

D3370 Practices for Sampling Water from Flowing Process Streams

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, see Terminology D1129.

3.2 *Symbols:*

3.2.1 Variables listed in this test method are defined in the individual sections where they are discussed. A list of defined variables is also given in Section 11.

3.2.2 *Explanation of Variables:*

$\bar{X}_t$ = total mean value

$\bar{X}_a$ = analytical mean value (calculated using data from analysis of standards)

S_{tt} = total standard deviation

S_{ta} = analytical standard deviation

S_{te} = estimated standard deviation due to the extraction procedure

S_{ot} = total single operator standard deviation

S_{oa} = analytical single operator standard deviation

S_{oe} = estimated single operator standard deviation due to the extraction procedure

4. Significance and Use

4.1 This test method is intended as a means for obtaining sequential extracts of a waste. The extracts may be used to estimate the release of certain constituents of the waste under the laboratory conditions described in this test method.

4.2 This test method is not intended to provide extracts that are representative of the actual leachate produced from a waste

[1] This test method is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.01.04 on Waste Leaching Techniques.

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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.

in the field or to produce extracts to be used as the sole basis of engineering design.

4.3 This test method is not intended to simulate site-specific leaching conditions. It has not been demonstrated to simulate actual disposal site leaching conditions.

4.4 An intent of this test method is that the final pH of each of the extracts reflects the interaction of the extractant with the buffering capacity of the waste.

4.5 An intent of this test method is that the water extractions reflect conditions where the waste is the dominant factor in determining the pH of the extracts.

4.6 This test method produces extracts that are amenable to the determination of both major and minor constituents. When minor constituents are being determined, it is especially important that precautions are taken in sample storage and handling to avoid possible contamination of the samples.

4.7 This test method has been tested to determine its applicability to certain inorganic components in the waste. This test method has not been tested for applicability to organic substances, volatile matter (see Note 3 in 5.15), or biologically active samples.

4.8 The agitation technique, rate, liquid-to-solid ratio, and filtration conditions specified in the procedure may not be suitable for extracting all types of wastes (see Sections 7, 8, and the discussion in Appendix X1).

5. Apparatus

5.1 *Straightedge,* such as a thin-edged yardstick.

5.2 *Impermeable Sheet,* of glazed paper, oil cloth, or other flexible material of a composition suitable to the analytes of interest.

5.3 *Drying Pans or Dishes*—Two per waste (for example, aluminum tins, porcelain dishes, or glass weighing pans), suitable to the waste being tested and the instructions given in 9.2.

5.4 *Drying Oven*—Any thermostatically controlled drying oven capable of maintaining a steady temperature of ±2 °C in a range from 100 to 110 °C.

5.5 *Desiccator,* having the capacity to hold the drying pans described in 5.3 and the crucibles described in 5.8.

5.6 *Laboratory Balance,* capable of weighing to 0.1 g.

5.7 *Pipet,* 10 mL capacity.

5.8 *Crucibles*—Two per waste, porcelain, 20 mL capacity each.

5.9 *Analytical Balance,* capable of weighing to 0.1 mg.

5.10 *Large Glass Funnel.*

5.11 *Wash Bottle,* 500 mL capacity.

5.12 *pH Meter*—Any pH meter with a readability of 0.01 units and an accuracy of ±0.05 units at 25 °C is acceptable.

5.13 *Agitation Equipment,* of any type that rotates the extraction vessel in an end-over-end fashion at a rate of 0.5 ± 0.03 Hz, such that the axis of rotation is horizontal and it goes through the center of the bottle (see Fig. 1 and the discussion of agitation in Appendix X1).

NOTE 1—Similar devices having a different axial arrangement may be used if equivalency can be demonstrated.

5.14 *Pressure Filtration Assembly*—A pressure filtration device of a composition suitable to the nature of the analyses to be performed and equipped with a 0.45 or 0.8 µm pore size filter (see Note 7, pertaining to 9.4).

5.15 *Extraction Vessels,* cylindrical, wide-mouth, of a composition suitable to the nature of the waste and analyses to be performed, constructed of materials that will not allow sorption of constituents of interest, and sturdy enough to withstand the impact of the falling sample fragments. Container size should be selected so that the sample plus extraction fluid occupy approximately 95 % of the container. Containers must have watertight closure. Containers for samples where gases may be released should be provided with a venting mechanism.

NOTE 2—Suitable container sizes range from 10 to 11 cm in diameter and 22 to 33 cm in height.

NOTE 3—Venting the container has the potential to affect the concentration of volatile compounds in the extracts.

5.15.1 Extraction vessels should be cleaned in a manner consistent with the analyses to be performed. See Section 13 of Practices D3370.

6. Reagents

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the American Chemical Society, where such specifications are available.[3] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean Type IV reagent water at 18 to 27 °C (Specification D1193). The method by which the water is prepared, that is, distillation, ion exchange, reverse osmosis, electrodialysis, or a combination thereof, should remain constant throughout testing.

7. Sampling

7.1 Obtain a representative sample of the waste to be tested using ASTM sampling methods developed for the specific industry where available (see Practice D75/D75M, Guide D420, Terminology D653, and Test Method D2234/D2234M).

7.2 Where no specific methods are available, sampling methodology for material of similar physical form shall be used.

7.3 The amount of sample to be sent to the laboratory should be sufficient to perform the solids content determination

[3] Reagent Chemicals, American Chemical Society Specifications, American Chemical Society, Washington, DC. For Suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.