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Standard Guide for Characterization of Inorganic Process Wastes for Use as Structural Fill¹

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1. Scope

1.1 This guide provides guidance for use of selected process wastes as structural fills by listing representative test methods for predicting and evaluating those physical characteristics of waste that are related to the integrity of fills and to protection of ground and surface waters.

1.2 **Table 1** lists references which provide engineering practices and test procedures that may be applied to process waste for use as structural fill.

1.3 This guide includes approaches for the environmental assessment of process wastes prior to application.

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:*²

- [C294 Descriptive Nomenclature for Constituents of Concrete Aggregates](#)
- [C295 Guide for Petrographic Examination of Aggregates for Concrete](#)
- [C593 Specification for Fly Ash and Other Pozzolans for Use With Lime for Soil Stabilization](#)
- [C821 Specification for Lime for Use with Pozzolans](#)
- [D420 Guide to Site Characterization for Engineering Design and Construction Purposes \(Withdrawn 2011\)](#)³
- [D421 Practice for Dry Preparation of Soil Samples for](#)

- [Particle-Size Analysis and Determination of Soil Constants \(Withdrawn 2016\)](#)³
- [D422 Test Method for Particle-Size Analysis of Soils \(Withdrawn 2016\)](#)³
- [D559 Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures](#)
- [D560 Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures](#)
- [D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)
- [D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort \(12,400 ft-lbf/ft³ \(600 kN-m/m³\)\)](#)
- [D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer](#)
- [D1140 Test Methods for Determining the Amount of Material Finer than 75- \$\mu\$ m \(No. 200\) Sieve in Soils by Washing](#)
- [D1452 Practice for Soil Exploration and Sampling by Auger Borings](#)
- [D1556 Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method](#)
- [D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort \(56,000 ft-lbf/ft³ \(2,700 kN-m/m³\)\)](#)
- [D1586 Test Method for Penetration Test \(SPT\) and Split-Barrel Sampling of Soils](#)
- [D1587 Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes](#)
- [D1633 Test Methods for Compressive Strength of Molded Soil-Cement Cylinders \(Withdrawn 2016\)](#)³
- [D2049 Test Method for Relative Density of Cohesionless Soils \(Withdrawn 1984\)](#)³
- [D2166 Test Method for Unconfined Compressive Strength of Cohesive Soil](#)
- [D2167 Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method](#)
- [D2216 Test Methods for Laboratory Determination of Water \(Moisture\) Content of Soil and Rock by Mass](#)
- [D2434 Test Method for Permeability of Granular Soils \(Constant Head\) \(Withdrawn 2015\)](#)³
- [D2487 Practice for Classification of Soils for Engineering Purposes \(Unified Soil Classification System\)](#)

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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.

³ The last approved version of this historical standard is referenced on www.astm.org.

- D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)
- D2573 Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils
- D2664 Test Method for Triaxial Compressive Strength of Undrained Rock Core Specimens Without Pore Pressure Measurements (Withdrawn 2005)³
- D2850 Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils
- D2937 Test Method for Density of Soil in Place by the Drive-Cylinder Method
- D3080 Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
- D3974 Practices for Extraction of Trace Elements from Sediments
- D3987 Practice for Shake Extraction of Solid Waste with Water
- D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- D5084 Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- D6938 Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

3.1.5 *fine material, n*— material finer than No. 200 (75- μ m) U.S. standard sieve.

3.1.6 *leachate, n*—liquid that has percolated through or passed over a solid waste or other medium and contains dissolved or suspended materials, or both, from the medium.

3.1.7 *process waste, n*—inorganic by-product materials such as mine tailings, culm piles, coal processing conversion and combustion wastes, cement and limekiln dust, by-product gypsum, and chemically treated compositions made from these wastes or waste mixtures.

3.1.8 *structural fill, n*—man-made deposits of solid materials. Examples include backfills, landfills, embankments, earth dams, linings and blankets, foundations, canals, road base, footings, and trenches.

4. Significance and Use

4.1 This practice is intended for inorganic process wastes that can be used as replacements for natural material such as soil or rock suitable for construction applications. Selection of appropriate and feasible fill materials and selection of applicable materials, tests, and specifications to facilitate construction and environmental protection are the responsibility of the design engineer. This practice is intended to encourage wider utilization of waste materials.

5. Determination of Material Characteristics

5.1 **Table 1** contains representative test methods recommended for determining and evaluating characteristics of process wastes, of either candidate or in situ fill materials. Appropriate numerical values of materials characteristics will vary depending on design requirements and are selected on the basis of accepted engineering practice and regulatory requirements. Testing of process wastes that may result in chemical reactions or contain cementitious materials should be performed on specimens that have been cured and aged to duplicate in situ conditions as closely as possible. Examples of such test procedures are listed in **Table 1** under Cemented Materials. Cured specimens carefully removed from the fill may be used in carrying out the laboratory or field procedures (**Table 1**). Solubility of the waste material must be suitable for the intended use.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *cemented materials, n*—materials consisting of one or more substances that develop hardness by chemical reaction after placement of the material in a fill.

3.1.2 *coarse material, n*—material coarser than a No. 200 (75- μ m) U.S. standard sieve.

3.1.3 *effective coefficient of permeability, n*—the coefficient of permeability that characterizes a fill and is the result of combined materials characteristics and construction techniques including compaction, capping, placement of impermeable layers, etc.

3.1.4 *fill material, n*— material used in the construction of a structural fill.

TABLE 1 Representative Test Methods Recommended for Determining and Evaluating Characteristics of Process Wastes Suitable for Fill Construction

Characteristics	Test Methods ⁴
General:	
Laboratory Procedures:	
Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soils Constants	D421
Particle-Size Analysis of Soils	D422
Liquid Limit of Soils	D4318
Plastic Limit and Plasticity Index of Soils	D4318
Terminology Relating to Soil, Rock, and Contained Fluids	D653
Moisture-Density Relations of Soils Using 5.5 lb Rammer and 12-in. Drop	D698
Specific Gravity of Soils	D854
Amount of Materials in Soils Finer than the No. 200 Sieve	D1140
Moisture-Density Relations of Soils Using 10 lb. Rammer and 18-in. Drop	D1557
Laboratory Determination of Moisture Content of Soil	D2216
Classification of Soils for Engineering Purposes	D2487