



## Standard Practice for Use of Inorganic Process Wastes as Structural Fill<sup>1</sup>

This standard is issued under the fixed designation E 850; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice 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 Some process wastes may produce leachate that exceeds environmentally acceptable limits. Special provisions are included to accommodate this class of materials (see 7.2).

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- C 294 Descriptive Nomenclature for Constituents of Natural Mineral Aggregate<sup>2</sup>
- C 295 Guide for Petrographic Examination of Aggregates for Concrete<sup>2</sup>
- C 593 Specification for Fly Ash and Other Pozzolans for Use with Lime<sup>3</sup>
- C 821 Specification for Lime for Use with Pozzolans<sup>3</sup>
- D 420 Guide to Site Characterization for Engineering, Design, and Construction Purposes<sup>4</sup>
- D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants<sup>4</sup>
- D 422 Test Method for Particle-Size Analysis of Soils<sup>4</sup>
- D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils<sup>4</sup>
- D 559 Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures<sup>4</sup>
- D 560 Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures<sup>4</sup>
- D 653 Terminology Relating to Soil, Rock, and Contained Fluids<sup>4</sup>
- D 698 Test Method for Laboratory Compaction Character-

- istics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))<sup>4</sup>
- D 854 Test Method for Specific Gravity of Soils<sup>4</sup>
- D 1140 Test Method for Amount of Material in Soils Finer Than the No. 200 (75- $\mu$ m) Sieve<sup>4</sup>
- D 1452 Practice for Soil Investigation and Sampling by Auger Borings<sup>4</sup>
- D 1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method<sup>4</sup>
- D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))<sup>4</sup>
- D 1586 Test Method for Penetration Test and Split-Barrel Sampling of Soils<sup>4</sup>
- D 1587 Practice for Thin-Walled Tube Sampling of Soils<sup>4</sup>
- D 1633 Test Method for Compressive Strength of Molded Soil-Cement Cylinders<sup>4</sup>
- D 2049 Test Method for Relative Density of Cohesionless Soils<sup>5</sup>
- D 2166 Test Method for Unconfined Compressive Strength of Cohesive Soil<sup>4</sup>
- D 2167 Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method<sup>4</sup>
- D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock<sup>4</sup>
- D 2217 Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants<sup>4</sup>
- D 2434 Test Method for Permeability of Granular Soils (Constant Head)<sup>4</sup>
- D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)<sup>4</sup>
- D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)<sup>4</sup>
- D 2573 Test Method for Field Vane Shear Test in Cohesive Soil<sup>4</sup>
- D 2664 Test Method for Triaxial Compressive Strength of Undrained Rock Core Specimens Without Pore Pressure Measurements<sup>4</sup>
- D 2850 Test Method for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression<sup>4</sup>

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D-34 on Waste Management and is the direct responsibility of Subcommittee D34.06 on Recovery and Reuse.

Current edition approved Oct. 10, 1995. Published December 1995. Originally published as E 850 – 82. Last previous edition E 850 – 88.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.08.

<sup>5</sup> Discontinued—See 1983 *Annual Book of ASTM Standards*, Vol 04.08. Replaced by D4253.

- D 2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)<sup>4</sup>
- D 2937 Test Method for Density of Soil in Place by the Drive-Cylinder Method<sup>4</sup>
- D 3017 Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)<sup>4</sup>
- D 3080 Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions<sup>4</sup>
- D 3974 Practice for Extraction of Trace Elements from Sediments<sup>6</sup>
- D 3987 Test Method for Shake Extraction of Solid Waste with Water<sup>7</sup>
- D 5084 Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter<sup>8</sup>

**3. Terminology**

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

3.2 *coarse material*— material coarser than a No. 200 (75-µm) U.S. standard sieve.

3.3 *effective coefficient of permeability*—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.

3.4 *fill material*— material used in the construction of a structural fill.

3.5 *fine material*— material finer than No. 200 (75-µm) U.S. standard sieve.

3.6 *leachate*—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.

3.7 *process waste*— 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.

3.8 *structural fill*— 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.

<sup>6</sup> Annual Book of ASTM Standards, Vol 11.02.  
<sup>7</sup> Annual Book of ASTM Standards, Vol 11.04.  
<sup>8</sup> Annual Book of ASTM Standards, Vol 04.09

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

Characteristics	Test Methods <sup>A</sup>
General:	
Laboratory Procedures:	
Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soils Constants	D 421
Particle-Size Analysis of Soils	D 422
Liquid Limit of Soils	D 4318
Plastic Limit and Plasticity Index of Soils	D 4318
Terminology Relating to Soil, Rock, and Contained Fluids	D 653
Moisture-Density Relations of Soils Using 5.5 lb Rammer and 12-in. Drop	D 698
Specific Gravity of Soils	D 854
Amount of Materials in Soils Finer than the No. 200 Sieve	D 1140
Moisture-Density Relations of Soils Using 10 lb. Rammer and 18-in. Drop	D 1557
Laboratory Determination of Moisture Content of Soil	D 2216
Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants	D 2217
Classification of Soils for Engineering Purposes	D 2487
Description of Soils	D 2488
Field Procedures:	