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Standard Guide for Use of Coal Combustion Products (CCPs) for Surface Mine Reclamation: Re-contouring and Highwall Reclamation¹

This standard is issued under the fixed designation E2243; 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 covers the use of coal combustion products (CCPs) for surface coal mine reclamation applications, as in beneficial use for reestablishing land contours, highwall reclamation, and other reclamation activities requiring fills or soil replacement. The purpose of this standard is to provide guidance on identification of CCPs with appropriate engineering and environmental performance appropriate for surface mine re-contouring and highwall reclamation applications. It does not apply to underground mine reclamation applications. There are many important differences in physical and chemical characteristics among the various types of CCPs available for use in mine reclamation. CCPs proposed for each project must be investigated thoroughly to design CCP placement activities to meet the project objectives. This guide provides procedures for consideration of engineering, economic, and environmental factors in the development of such applications, and should be used in conjunction with professional judgement. This guide is not intended to replace the standard of care by which the adequacy of a given professional service must be judged, nor should this guide be applied without consideration of a project's unique aspects.

1.2 The utilization of CCPs under this guide is a component of a pollution prevention program; Guide E1609 describes pollution prevention activities in more detail. Utilization of CCPs in this manner conserves land, natural resources, and energy.

1.3 This guide applies to CCPs produced primarily from the combustion of coal.

1.4 The testing, engineering, and construction practices for using CCPs in mine reclamation are similar to generally accepted practices for using other materials, including cement and soils, in mine reclamation. For guidance on structural fills to be constructed at mine sites, see applicable ASTM guide for coal ash structural fills.

¹ This guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.03 on Beneficial Use.

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1.5 Regulations governing the use of CCPs vary by state. The user of this standard guide has the responsibility to determine and comply with applicable regulations.

1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.7 *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.*

1.8 *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

- C188 Test Method for Density of Hydraulic Cement
- C311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
- D75 Practice for Sampling Aggregates
- D420 Guide for Site Characterization for Engineering Design and Construction Purposes
- D422 Test Method for Particle-Size Analysis of Soils (Withdrawn 2016)³
- 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

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.

- D1195** Test Method for Repetitive Static Plate Load Tests of Soils and Flexible Pavement Components, for Use in Evaluation and Design of Airport and Highway Pavements
- D1196** Test Method for Nonrepetitive Static Plate Load Tests of Soils and Flexible Pavement Components, for Use in Evaluation and Design of Airport and Highway Pavements
- D1452** Practice for Soil Exploration and Sampling by Auger Borings
- 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 Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
- D1883** Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils
- D2166** Test Method for Unconfined Compressive Strength of Cohesive Soil
- D2216** Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- D2435** Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading
- D3080** Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
- D3550** Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
- D3877** Test Methods for One-Dimensional Expansion, Shrinkage, and Uplift Pressure of Soil-Lime Mixtures (Withdrawn 2017)³
- D4253** Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
- D4254** Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- D4429** Test Method for CBR (California Bearing Ratio) of Soils in Place (Withdrawn 2018)³
- D4448** Guide for Sampling Ground-Water Monitoring Wells
- D4767** Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
- D4972** Test Methods for pH of Soils
- D5084** Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- D5239** Practice for Characterizing Fly Ash for Use in Soil Stabilization
- D5851** Guide for Planning and Implementing a Water Monitoring Program
- E1609** Guide for Development and Implementation of a Pollution Prevention Program (Withdrawn 2010)³
- E2201** Terminology for Coal Combustion Products

2.2 *AASHTO (American Association of State Highway and Transportation Officials) Standards:*⁴

- T 288** Determining Minimum Laboratory Soil Resistivity
- T 289** Determining pH of Soil for Use in Corrosion Testing

- T 290** Determining Water Soluble Sulfate Ion Content in Soil
- T 291** Determining Water Soluble Chloride Ion Content in Soil

2.3 *Other Methods()*:

- EPA Method 1312 Synthetic Precipitation Leaching Procedure (SPLP) (1)**⁵
- EPA Method 1320 Multiple Extraction Procedure (MEP) (2)**
- EPA Method Monofill Waste Extraction Procedure (MWEP) (3)**
- Synthetic Ground water Leaching Procedure (SGLP) (4)**
- Long-Term Leaching Procedure (LTL) (4)**

3. Terminology

3.1 *Definitions*—For definitions related to coal combustion products, see Terminology **E2201**. For definitions related to geotechnical properties, see Terminology **D653**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *internal erosion*—piping; the progressive removal of soil particles from a mass by percolating water, leading to the development of channels.

3.2.2 *permeability*—the capacity to conduct liquid or gas. It is measured as the proportionality constant, k , between flow velocity, v , and hydraulic gradient, i ; $v = ki$.

4. Background

4.1 *Significance and Use*—CCPs can be effective materials for use for reclamation of surface mines. Following are key scenarios in which CCPs may be utilized beneficially in a mined setting:

Structural fill
Road construction
Soil modification or amendment for revegetation (**5-9**)
Isolation of acid forming materials (**5**)
Reduction of acid mine drainage (AMD) (**5,10-15**)
Highwall mining (**16,17**)

4.1.1 These options represent most, but not all, scenarios under which CCPs would be returned to the mine. This guide discusses issues related to highwall mining and recontouring. Because of the chemical and physical characteristics of CCPs and the benefits derived from the use of CCPs in these applications, placement of CCPs in a surface mine setting qualifies as a beneficial use as defined in Terminology **E2201**.

4.1.2 CCPs are ideally suited for use in numerous fill applications. Structural fills and other high-volume fills are significant opportunities for placement of CCPs in mine situations for reclamation, recontouring, and stabilizing slopes. These applications are the focus of this guide.

4.1.3 Any type of CCP may be evaluated for use in mine reclamation, even fly ash with high carbon content. Project-specific testing is necessary to ensure that the CCPs selected for use on a given project will meet the project objectives. The use of CCPs can be cost effective because they are available in bulk quantities and reduce expenditures for the manufacture

⁴ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

⁵ The boldface numbers in parentheses refer to the list of references at the end of this guide.