Designation: D7762 – 18

Standard Practice for Design of Stabilization of Soil and Soil-Like Materials with Self-Cementing Fly Ash[1]

This standard is issued under the fixed designation D7762; 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 practice covers procedures for the design of stabilization of soil and soil-like materials using self-cementing coal fly ash for roadway applications, treatment of expansive subgrade or organic subgrade, and limiting settlement of fills below buildings. The coal fly ash covered in this method includes self-cementing fly ashes described in Specification D5239.

1.2 The testing and engineering practices for self-cementing coal fly ash are similar to generally accepted practices for soil stabilization with fly ash and other pozzolans that require lime.

1.3 The test methods in this practice are applicable to the characterization of mechanical properties of *in situ* mixed self-cementing fly ash stabilized materials. Follow Practice D75 for sampling purposes. There are other related fly ash stabilization standards. Practice D5239 can be used to characterize the general types of fly ash for use in soil stabilization. Specification C593 can be used to evaluate the performance of fly ash and other pozzolans that require lime soil stabilization. Guide E2277 can be used to characterize properties of fly ash and bottom ash in structural fills and related design and construction considerations.

1.4 The standard units are the SI units, unless other units are specified.

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 practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

1.7 *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]

C593 Specification for Fly Ash and Other Pozzolans for Use With Lime for Soil Stabilization

C597 Test Method for Pulse Velocity Through Concrete

D75 Practice for Sampling Aggregates

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/ft^3 (600 kN-m/m^3))

D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D1883 Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils

D4609 Guide for Evaluating Effectiveness of Admixtures for Soil Stabilization (Withdrawn 2017)[3]

D5102 Test Methods for Unconfined Compressive Strength of Compacted Soil-Lime Mixtures

D5239 Practice for Characterizing Fly Ash for Use in Soil Stabilization

D5918 Test Methods for Frost Heave and Thaw Weakening Susceptibility of Soils

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.14 on Geotechnics of Sustainable Construction.

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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.

E2201 Terminology for Coal Combustion Products
E2277 Guide for Design and Construction of Coal Ash Structural Fills

2.2 *AASHTO (American Association of State Highway and Transportation Officials) Standard:*[4]
AASHTO T 307 Standard Method of Test for Determining the Resilient Modulus of Soils and Aggregate Materials

2.3 *TRB (Transportation Research Board) Standard:*[5]
NCHRP 1-28A Harmonized Test Method for Laboratory Determination of Resilient Modulus for Flexible Pavement Design

2.4 *ACAA (American Coal Ash Association) Soil Stabilization Manual:*[6]
Soil Stabilization and Pavement Recycling with Self-Cementing Coal Fly Ash

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions related to coal combustion products, refer to Terminology E2201. For definitions of common technical terms in this standard, refer to Terminology D653.

4. Significance and Use

4.1 Self-cementing coal fly ashes are suitable materials for the stabilization of soils, recycled pavement materials and road surface gravel. Fly ash stabilization can result in improved properties, including increased stiffness, strength and freeze-thaw durability; reduced hydraulic conductivity, plasticity, and swelling; and increased control of soil compressibility and moisture. Fly ash stabilized materials (FASM) may be used in roadway construction, such as working platforms during construction, stabilized subgrade, subbase, and base layers. Fly ash stabilization can also be used in limiting settlement of fills below buildings.

4.2 This practice is intended for use with self-cementing fly ash that can be used individually or along with other stabilizing admixtures to improve soil properties.

4.3 The practice describes the unique design considerations that may apply to stabilization of soils and soil-like materials with self-cementing coal fly ash. The requirements for stabilization of specific materials may vary due to local conditions or the intended use of the stabilized material, or both.

4.3.1 This practice is not intended to limit the flexibility of design in stabilization. The degree of success attained in stabilization with coal fly ash is highly dependent on the particular combination of soil, fly ash, and other additives and the construction procedure used. The selection of appropriate materials, applicable tests, acceptance criteria, and specification is the responsibility of the design engineer.

4.4 The test methods in this practice are intended for the determination of mechanical properties of FASM. The characterization of mechanical property improvement with self-cementing fly ash will assist in the evaluation of the fly ash stabilized materials.

4.5 The use of self-cementing fly ash in geotechnical engineering applications may be regulated by state and local codes. The codes should be consulted.

5. Stabilization Applications

5.1 *General*—High calcium oxide content and self-cementing properties of subbituminous coal fly ash (self-cementing fly ash) can be used effectively in stabilization, such as drying wet soils to facilitate compaction and increase subgrade support, improving stiffness and strength and reducing compressibility of both cohesive soils and granular materials. However, the effectiveness depends on specific material to be stabilized and specific fly ash and has to be determined on a case-specific basis.

5.2 *Stabilization of Fine-Grained Soils*—In the fly ash stabilization of fine-grained soils, flocculation, agglomeration, and cementitious reactions may occur. Self-cementing coal fly ash has been demonstrated to be an effective stabilization agent for a range of fine-grained soils in increasing subgrade support capacity for pavements, in reducing swelling potential of expansive soils, in increasing shear strength of organic soils and fine-grained soils, and in reducing the compressibility of fills under foundations. The fly ash stabilized section also provides a more stable platform (working platform) during pavement construction over very soft subgrades. Such stabilized subgrade working platforms can be treated as a subbase section in the pavement thickness design.

5.3 *Stabilization of Coarse-Grained Materials*—In coarse-grained materials, such as aggregate base, gravels, recycled pavement materials, recycled road surface gravel, cementation through pozzolanic reactions and hydration within the self-cementing coal fly ash can cause strength gain and enhance durability. The reaction rate depends on the self-cementing coal fly ash used.

5.4 *Pavement Recycling: Full Depth Reclamation*—Recycling or reclaiming existing flexible pavements with self-cementing fly ash as a stabilizing agent has been demonstrated to be an efficient and economical method of pavement rehabilitation for roadways. The process is accomplished by pulverizing the entire pavement section down to the subgrade and stabilizing the pulverized mixture by adding self-cementing coal fly ash and water (as needed). The recycled section provides an enhanced base for a new hot mix asphalt (HMA) wearing surface. Self-cementing fly ash stabilized recycled sections have structural capacities (enhanced modulus and reduced plastic deformations), which are considerably better than a crushed-stone aggregate base and can be equivalent to an asphaltic concrete base section.

5.5 *Gravel Road Recycling: In Situ Reclamation*—Recycling or reclaiming existing road surface gravel (RSG) with self-cementing fly ash stabilization is an economical method for converting gravel roads to paved roads. The

[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] National Cooperative Highway Research Program, Transportation Research Board, Washington, DC.

[6] American Coal Ash Association Educational Foundation, 15200 E. Girard Ave., Suite 3050, Aurora, Colorado 80014-3955.