Designation: D7765 – 18

Standard Practice for Use of Foundry Sand in Structural Fill and Embankments[1]

This standard is issued under the fixed designation D7765; 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 methods to use foundry sand as embankment and structural fill.

1.2 This practice includes recommended construction (Section 5), compaction control (Section 6), and freeze-thaw durability (Section 7) practices.

1.3 The engineer should be aware that foundry sand is a by-product of metal casting industries. Various local, state/provincial/regional, or national/federal environmental laws and regulations may apply if foundry sand is used as an alternative embankment or fill material. It is advised that foundry sand users contact appropriate environmental regulators to determine what requirements or limitations may exist.

1.4 This standard applies to both green foundry sand and chemically bonded foundry sand.

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

1.6 *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.*

1.7 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 guide 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.

1.8 *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]

C837 Test Method for Methylene Blue Index of Clay

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))

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/ft^3 (2,700 kN-m/m^3))

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

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

D2974 Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D4327 Test Method for Anions in Water by Suppressed Ion Chromatography

D5080 Test Method for Rapid Determination of Percent Compaction

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

D6026 Practice for Using Significant Digits in Geotechnical Data

D6938 Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

G51 Test Method for Measuring pH of Soil for Use in Corrosion Testing

G187 Test Method for Measurement of Soil Resistivity Using the Two-Electrode Soil Box Method

[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. Terminology

3.1 *Definitions:*

3.1.1 For definitions of common technical terms in this standard, refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *active clay content, n*—the clay fraction that still can be hydrated.

3.2.2 *binders, n*—additives used to hold the sand in the required shape during the casting process. Binders may be inorganic, such as bentonite clay and sodium silicate, or organic such as phenolic-urethanes and epoxy-resins.

3.2.3 *chemically bonded sand, n*—foundry sand that contains non-bentonite binders.

3.2.4 *foundry sand, n*—a narrowly graded fine sand with subangular to rounded grains that is a by-product of the steel and aluminum casting industry.

3.2.5 *green foundry sand, n*—a mixture of foundry sand, bentonite and seacoal. Most of foundry sand generated is green foundry sand that contains bentonite clay and carbonaceous additives, such as seacoal. Bentonite content of the green foundry sands is the key characteristic that affects their behavior.

3.2.6 *seacoal, n*—a carbonaceous material added to foundry sand to provide a reducing environment during casting and to help ease the release of the cooled metal from the mold.

4. Significance and Use

4.1 Earthwork associated with highway construction provides an opportunity for high volume reuse of green foundry sands discarded by the foundry industry. This practice covers methods and recommendations to use of foundry sand as embankment and structural fill.

4.2 This practice describes the unique construction considerations that may apply to foundry sands. The behavior may vary due to specific composition of the material and local conditions.

4.3 The use of foundry sand in embankment and structural fill may be regulated by local, state/provincial/regional, or national/federal regulations. These regulations should be consulted.

4.4 This practice is intended for use with green foundry sands where bentonite is used as the binder. It may not be applicable for chemically bonded foundry sands.

5. Construction Practices

5.1 The following practices are recommended when constructing foundry sand embankment and structural fill.

5.1.1 Foundry sand should be conditioned for dust control and to prevent erosion by the addition of between 10 and 15 percent water by mass at the source site prior to delivery. This conditioning may include subsequent storage (stockpiling) of the foundry sand for a period of 24 h or more, after the addition of water, until the water is evenly dispersed. If the supplier can demonstrate that water is evenly distributed throughout the foundry sand, then stockpiling may not be required.

5.1.2 Delivery of foundry sand should be in closed or covered trucks.

5.1.3 Large-scale storage (stockpiling) of foundry sand at the site is permissible provided that the water content is maintained at 10 to 15 percent by mass for dust control.

5.1.4 Foundry sand material should be spread into loose lifts of approximately 200 mm thickness. The engineer may consider thicker lift dimensions if it can be satisfactorily demonstrated with a test section that adequate compaction can be achieved over the full depth of the thicker lift.

5.1.5 If necessary for proper compaction, water should be added to the foundry sand by the use of water distribution tank trucks. The water and foundry sand should be mixed using a rototilling mixer or other approved method. At the time of compaction, the foundry sand should have a moisture content that will result in an after compaction dry density that complies with the requirements of the project specifications. The dry density is a function of the clay content.

5.1.6 The first pass in the compaction process should be accomplished by the method known as tracking. This involves the use of a bulldozer track to accomplish initial compaction. The bulldozer is moved progressively across the foundry sand until the entire area is tracked.

5.1.7 The foundry sand should subsequently be compacted using pneumatic tired compaction equipment. Smooth steel drum and vibratory steel drum compactors are not as effective as pneumatic tired compactors for compacting foundry sand.

5.1.8 The foundry sand embankment should be compacted as required by the specifying agency. The dry density is a function of the clay content. Foundry sand with no clay should have a dry density equal to or greater than 1600 kg/m^3 with an optimum water content of approximately 9 %. Increasing clay content will increase dry density and optimum water content.

5.1.9 At the completion of each day's work, the surface of the foundry sand embankment should be sealed. This means that it should be graded after compaction to the specification requirement and rolled with a smooth steel roller so that rain will flow off the foundry sand instead of puddling.

5.1.10 The contractor should use water or other dust palliatives, if necessary, to control the generation of dust due to drying of the foundry sand.

6. Compaction Control

6.1 The use of foundry sand as structural fill and embankment material can present compaction-related issues that may be different from those encountered with conventional sandy materials. Bentonite content of the green foundry sands is the key characteristic affecting their constructability and performance. The active clay content can be determined by using methylene blue titration following Test Method C837. A description of the issues and recommended practices for mitigation are presented below.

6.1.1 The moisture-density relationship for foundry sand will vary depending on the sand type and the amount of clay. Hydration of dehydrated clay in foundry sands takes at least 1