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Standard Guide for Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes[1]

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1. Scope

1.1 This guide covers the material characteristics, physical requirements, and sampling appropriate for the designation of the material as a mineral amendment.

1.2 The presence in the topsoil of the correct nutrient and pH level is necessary for healthy plant growth. This guide does not, however, cover a determination of the nutrients, nor their availability.[2]

NOTE 1—The nutrient content of topsoil is important and the chemicals usually evaluated are nitrogen, phosphate, and potassium. Nutrient deficiencies may be corrected by using fertilizers. Excess soluble salts should be examined as to their desirability. The acidity or alkalinity of the soil is also important. Excess acidity may be corrected by the application of lime dust. Excess alkalinity may be corrected by the application of sulfur or other suitable acidifying compounds. The latter item, in addition to lowering pH, also could be considered as an aggregate when considering the particle size distribution.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. 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.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 29/C 29M Test Method for Unit Weight and Voids in Aggregate[3]

C 566 Test Method for Total Moisture Content of Aggregate by Drying[3]

D 75 Practice for Sampling Aggregates[4]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[5]

D 1140 Test Method for Amount of Material in Soils Finer than No. 200 (75μ m) Sieve[5]

D 4972 Test Method for pH of Soils[5]

D 5268 Specification for Topsoil Used for Landscaping Purposes[5]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[6]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *amendment, physical*—any substance, such as sand, calcined clay, peat, or sawdust, added to the soil to alter its physical properties.

3.2.2 *slit trench drain*—a narrow trench (usually 5 to 10 centimeters wide) back-filled to the surface with a material, such as sand, gravel, or crushed rock, to facilitate surface or substance drainage.

3.2.3 *soil amendment (physical), n*—any substance, such as sand, calcined clay, shale or slate, peat or sandust, added to the soil to alter its physical properties.

3.2.4 *soil modification, n*—alteration of soil characteristics by addition of physical amendments: commonly used to

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[2] Nutrient testing procedures are found in the state Agricultural Experiment Station recommendations from the state within which the landscape is located," Methods of Soil Analysis" Editor-in-Chief: C. A. Black, *Agronomy No. 9*, Vol 2, American Society of Agronomy, Inc., Madison, WI, and Hesse, P.R., *A Textbook of Soil Chemical Analysis*, Chemical Publishing Co., New York, NY 1972.

[3] *Annual Book of ASTM Standards*, Vol 04.02.

[4] *Annual Book of ASTM Standards*, Vol 04.03.

[5] *Annual Book of ASTM Standards*, Vol 04.08.

[6] *Annual Book of ASTM Standards*, Vol 14.02.

improve physical conditions of soils.

3.2.5 *soil probe*—a soil sampling tool having a hollow cylinder with a cutting edge at the lower end.

3.2.6 *topdressing, n*—a prepared soil mix added to a turf surface and usually physically worked in by matting, raking, irrigating, or all three, to a smooth surface.

3.2.7 *topsoil, n*—usually the original surface layer of grassland or cultivated land. Topsoil does not generally include soil from peatlands or other special areas, such as land disturbed by industrial activity. Topsoil is usually a darker shade of brown, gray, or red than the subsoil that lies immediately beneath it, because it contains organic matter intimately mixed with the mineral matter. Topsoil tends to be more friable and pervious than inorganic soils.

4. Significance and Use

4.1 When physically evaluating a soil, relative to its suitability to support plant growth (primarily grasses), tests must be performed to determine the presence and amount of solid matter (organic and inorganic) compatibility that can determine potential air-void content and water-holding ability, and finally, deleterious materials.

4.2 Typical general ranges of soil content for suitable topsoils are presented in Specification D 5268. It should be recognized, however, that in some geographic regions, concurrence with the values in the referenced table would be difficult. In such situations, locally acceptable specifications need to be developed.

5. Function and Material

5.1 *Function*—The potential/success of a topsoil amendment is measured/determined by its ability to provide some or all of the desired properties/characteristics of the topsoil that are absent in the unamended topsoil or soil. Soils consist essentially of three space-occupying components: water, air voids, and solid particulate matter. The third component can be further divided into two sub-components: organic matter, such as peat, muck or other decayed matter: and inorganic mineral matter, such as clay, silt and sand. ESCS falls into the latter group of the third component sub-component group, as a better substitute for sand.

5.2 *Material*—ESCS, is a rotary kiln produced vesicular amorphous silicate particulate material. It is a highly porous, low density material with an apparent specific gravity of approximately 0.8 to 2.4, and a dry/loose unit weight of approximately 35 to 70 lb/ft^3, (561 to 1121 kg/m^3). The pre-sized raw shale, clay or slate used to produce ESCS is fired in the kiln at a temperature between 1800°F (982°C) and 2200°F (1205°C). As it exits the kiln the material is sterile, inert, and ceramic. Some crushing may be performed to facilitate final sizing in a screening system. ESCS in generally neutral in pH although the pH can vary somewhat depending on the raw material and the fuel in the kiln. Density, or loose unit weight, is determined by Test Method C 29/C 29M. The absorption may be determined by Test Method C 566 after soaking the sample a sufficient period of time, usually 3 to 7 days, depending on the source and the grading of the material. The particle distribution may be determined with appropriate sieves as stated in Specification E 11. The ESCS may be sampled in accordance with Practice D 75.

6. Application

6.1 ESCS is generally used in horticultural topsoil applications as a substitute for the sand sub-component of soil's solid component (see Specification D 5268, Table 1). The main adjustment that needs to be made is a correction for the weight and volume relationship of ESCS fines, that is, the minus No. 4 (4.75 mm) sieve size to a similar size of sand. The oven-dry or saturated surface dry/loose unit weight tests (see Test Method C 29/C 29M) can be performed to establish the weight-volume relationship. Typically, a loose cubic foot of ESCS fines will weigh approximately from 35 lb/ft^3(560 kg/m^3 to 70 lb/ft^3) (1120 kg/m^3) depending on the source. Absorption of ESCS varies with the source, but is usually from approximately 18 % to 35 % of the oven-dry loose unit weight. Several blends of topsoil using ESCS with or in place of the sand should be prepared and evaluated with regard to potential for aeration, moisture retention, resistance to compaction, and the other items covered in Specification D 5268.

NOTE 2—ESCS was originally patented as Haydite in 1918. It has been used in horticultural research as well as in private and commercial plant (and grass) soil modification management in the United States and Europe since the early 1920s. It is used extensively in hydroponics, as well.

7. Keywords

7.1 horticulture; landscaping; mineral amendment Haydite; soil; soil amendment; modification; topsoil