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Standard Test Method for Determination of Water/Cementitious Materials Ratio for Geosynthetic Cementitious Composite Mats (GCCMs) and Measurement of the Compression Strength of the Cementitious Material Contained Within[1]

This standard is issued under the fixed designation D8329; 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 The purpose of the proposed test method is to obtain a water/cementitious material ratio that allows for a practical measurement of the compressive strength of the cementitious material contained within a geosynthetic cementitious composite mat (GCCM). This water/cementitious material ratio should be generally representative of that achieved practically upon the hydration of a GCCM. Because GCCM materials do not involve mixing or the use of exact water hydration methods when employed in the field, this method is necessary to provide a quantitative estimate of the water/cementitious material ratio.

1.2 This procedure determines the water/cementitious material ratio for a properly hydrated GCCM, which is then used to create cube or cylinder specimens for compressive strength testing as per the appropriate referenced ASTM test methods. Compressive strength results will then be representative of the strength of the inherent cementitious material found in the GCCM after normal GCCM hydration.

1.3 The values in SI units are to be regarded as standard. Values in inch-pound units are in parentheses for information.

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

1.5 *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]

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens)

D4439 Terminology for Geosynthetics

D8030/D8030M Practice for Sample Preparation for GCCM

[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.05 on Geosynthetic Erosion Control.

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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.

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3. Terminology

3.1 *Definitions:*

3.1.1 *deconsolidation, n*—process by which the specimens are exercised and loosened such that they approximate a GCCM that has been deployed in the field.

3.2 For definitions of other terms used in this standard, refer to Terminology D4439.

4. Summary of Test Method

4.1 This method involves measuring the mass per unit area of uncured GCCM samples, measuring the mass per unit area of the geosynthetic portion(s), and using this to calculate the mass per unit area of the cementitious material contained within the GCCM. This mass per unit area of the cementitious material is used in conjunction with the mass per unit area of the cured saturated surface dry (SSD) GCCM to determine the water/cementitious material ratio representative of a properly cured and hydrated GCCM. This water/cementitious material ratio then forms the basis for laboratory preparation of the same cementitious material for specimens which will then be tested for compressive strength as per the appropriate ASTM standard methods.

5. Significance and Use

5.1 Hydration is a critical aspect of GCCM installation. GCCM installations are often hydrated with excess water to ensure that a saturated condition exists. Therefore, it is not generally possible to monitor and control exactly the water addition that absorbs and hydrates the cementitious materials due the practical methods of hydration in use.

5.2 It is important to be able to distinguish the quality of cementitious material used in applications for GCCMs. A measurement of compressive strength properties of the cementitious material is often an accepted method to provide a measure of the cement strength and quality. The compressive strength properties will vary with the water/cementitious material ratio and, therefore, it is necessary to determine a practical value that approximates in-use hydration and not a water/cementitious material ratio that simply provides the maximum properties but cannot be expected as representative of actual use conditions.

5.3 The compressive strength of the cementitious material can be affected by both over and under hydration.

5.4 This method identifies a means to obtain a water/cementitious material ratio representative of that obtained by proper hydration of GCCMs to allow replication for laboratory compressive strength testing for use by GCCM designers, inspectors, and installers.

6. Apparatus

6.1 Laboratory oven capable of 100 °C and maintaining a constant temperature within ±2 °C.

6.2 Laboratory balance capable of measurement to ±0.5 g accuracy.

6.3 Length measurement device capable of measurement to ±2 mm accuracy.

6.4 Cylinder or pipe with outer diameter of between 50 and 75 mm and minimum 300 mm length.

6.5 Absorbent pads or paper towels.

7. Sampling, Test Specimens, and Test Units

7.1 Specimens shall be a minimum of 300 mm by 300 mm square but no larger than 400 mm by 400 mm.

7.2 ~~A~~ Prepare a minimum of ~~five specimens shall be obtained as part of this standard to produce~~ten (10) uncured specimens according to Practice D8030/D8030M~~average values for the water/cementitious material ratio.~~, Procedure A. An even number of specimen must be prepared.

7.3 Record the dry (uncured) specimen weight in grams to the nearest 0.5 g or less. Measure the width and length of the specimen to ±2 mm.

7.4 Calculate the mass per unit surface area of each uncured specimen as per Eq 1:

$$M_i = \frac{W_i}{L_i \times D_i} \quad (1)$$

where:

M_i = mass per unit area (g/mm^2) of component i,
i = specific component(s) including geosynthetic material, cementitious material, water, or combinations thereof,
W_i = mass of the GCCM, g,
L_i = length of the GCCM specimen, mm, and
D_i = width of the GCCM specimen, mm.

7.5 Order the specimens from lowest mass per unit surface area to the highest mass per unit surface area and label them from 1 (lowest) to 10 (highest).

7.6 Use odd number specimens (1, 3, 5, 7, 9…) in 8.1 and use even number specimens (2, 4, 6, 8, 10…) in 8.2.

8. Procedure

8.1 *Determination of Geosynthetic Portion(s) and Cementitious Material Portion of the GCCM Mass per Unit Surface Area:*

8.1.1 ~~Prepare a minimum of five specimens of 300 mm by 300 mm dry (uncured) specimens according to Practice~~ Using ~~D8030/D8030M, Procedure A. Record the dry (uncured) specimen weight~~ the odd number specimens in 7.6~~grams to the nearest 0.5 g or less. Measure the width and length of the specimen to ±2 mm. Calculate the~~, calculate the average value of mass per unit surface area ~~of the uncured specimens as per~~ (Eq 1~~. Calculate and average values from all~~) for the minimum of five specimens.

$$M_i = \frac{W_i}{L \times D} \quad (1)$$

~~where:~~

~~M_i = mass per unit area (g/mm^2) of component i,~~
~~i = specific component(s) including geosynthetic material, cementitious material, water, or combinations thereof,~~
~~W_i = mass of the GCCM, g,~~
~~L = length of the GCCM specimen, mm, and~~
~~D = width of the GCCM specimen, mm.~~

8.1.2 Remove the cementitious material from the specimen to the largest extent possible and reweigh the vacated specimen to determine geosynthetic material weight. Removal of the cementitious mix may be achieved through a combination of cutting and agitating, but care should be taken to not lose any geosynthetic material. Record the dry unit weight of the geosynthetic portion of the GCCM specimen to the nearest 0.5 g or less. Use the dry geosynthetic weight to calculate the mass per unit surface area (g/mm^2) of the geosynthetic material as per Eq 1. Calculate and average the values from all ~~five~~the specimens.

8.1.3 Calculate the cementitious material mass per unit area of each specimen by subtracting the geosynthetic material mass per unit area, as determined in 8.1.2, from the dry specimen mass per unit area, as determined in ~~8.1.1~~7.4. Calculate and average values from all ~~five~~the specimens. The cementitious material portion of the GCCM will include all cementitious materials or dry powders that are intended to be hardened upon hydration. The cementitious material shall include any cements, binder, aggregates, fillers, or dry admixtures.

8.2 *Determination of Water/Cementitious Material Ratio of Hydrated Specimens:*

8.2.1 ~~Prepare a minimum of five additional~~Using the even number specimens in 7.6~~specimens of 300 mm by 300 mm dry (uncured) GCCM according to~~, calculate the average value of mass per unit surface area (Eq 1 ~~Practice~~) for ~~D8030/D8030M, Procedure A.~~the minimum of five specimens.

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