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Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetative (Green) Roof Systems[1]

This standard is issued under the fixed designation E2398/E2398M; 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 test method covers the determination of the water and media retention of synthetic drains layers used in vegetative (green) roof systems.

1.2 This test method is applicable to geocomposite drain layers that retain water and media in cup-like receptacles on their upper surface. Examples include shaped plastic membranes and closed-cell plastic foam boards.

1.3 This test method does not apply to products manufactured from water-absorptive materials.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C920 Specification for Elastomeric Joint Sealants

E631 Terminology of Building Constructions

E2114 Terminology for Sustainability Relative to the Performance of Buildings

E2397 Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems

3. Terminology

3.1 *Definitions:*

3.1.1 For terms related to building construction, refer to Terminology E631.

3.1.2 For terms related to sustainability relative to the performance of buildings, refer to Terminology E2114.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *captured water, n*—the quantity of water that is retained in the drainage layer of a vegetative (green) roof system after new water additions have ceased and that cannot escape the roof except through evaporation or plant transpiration.

3.2.2 *coupon, n*—a portion of a material or laboratory sample from which multiple specimens can be taken for testing.

3.2.3 *geocomposite drain layer, n*—a synthetic sheet, mat, or panel that is specifically designed to convey water horizontally toward the roof deck drains, gutters, or scuppers.

3.2.3.1 *Discussion*—Geocomposite drainage layers include absorptive drainage mats whose principle function is drainage, but which will also contribute to water retention (see *retained water*). Some geocomposite drainage layers may incorporate receptacles on their upper surfaces that will capture water (see *captured water*).

3.2.4 *retained water, n*—the quantity of water that will be retained for a prolonged period against gravity drainage in a vegetative (green) roof system, or in one of its components, after new additions by rainfall or artificial irrigation have ceased.

3.2.4.1 *Discussion*—Most of this water will not become runoff but will be used to the plant-mediated processes of evapo-transpiration.

3.2.5 *unit media retention volume, n*—the volume, ft^3/ft^2 [cm^3/cm^2], that is required to fill a geocomposite drain layer to the upper most asperities of the geocomposite drain layer.

3.2.6 *unit water capture volume, n*—the maximum volume of water, ft^3/ft^2 [cm^3/cm^2], that a geocomposite drain layer can hold at a specified inclination.

3.2.6.1 *Discussion*—For vegetative (green) roofs systems where the geocomposite drain layer will be filled with granular drainage medium, the actual volume is assumed to be 25 % of the measured volume. This assumption will allow a direct

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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.

comparison between geocomposite sheet drains without, regard to the granular drainage media used. In computing the actual water capture of a geocomposite sheet drain employed in a specific vegetative (green) roof assembly, the porosity of the granular drainage medium used must be considered (Practice E2397).

4. Summary of Test Method

4.1 This procedure provides a method for measuring the volume of granular media or water, or both, that geocomposite drain layers can hold. The test involves filling the geocomposite drain layers with sand and water to establish the respective volumes. Since water capture will be influenced by the inclination of the geocomposite drain layer, the tests are conducted at several inclinations.

5. Significance and Use

5.1 Determining these performance characteristics of vegetative (green) roof systems provides information to facilitate the assessment of related engineering aspects of the facility. Such aspects may include structural design requirements, mechanical engineering and thermal design requirements, and fire and life safety requirements.

5.1.1 Accurate information about the water and media holding capacity of geocomposite drain layers is essential to predict dead load for vegetative (green) roof systems.

5.2 Determining these performance characteristics of vegetative (green) roof systems provides information to facilitate assessment of the performance of one vegetative (green) roof system relative to one another.

5.2.1 Water capture is also useful in assessing irrigation requirements for vegetative (green) roof designs.

5.2.2 Information about the unit media retention volume is required to predict the quantity of material that will be required to construct a vegetative (green) roof with a specified total thickness.

6. Apparatus

6.1 *Apparatus*—contains the following:

6.1.1 Scale, accurate to 0.005 oz [0.14 g],

6.1.2 Scoop,

6.1.3 Water dropper,

6.1.4 4-in. [10-cm] wide strip of aluminum or copper sheet metal,

6.1.5 Elastomeric sealant complying with Specification C920, and

6.1.6 Ruler.

7. Conditioning

7.1 Cut out a rectangular coupon of the geocomposite drain layer to be tested.

7.2 The coupon should contain only complete, intact receptacles. The coupon should contain a minimum of four receptacles and be at least 6 in. [15 cm] square.

8. Procedure

8.1 Weigh the coupon in a dry condition, and record.

8.2 With the coupon on a level surface, fill the receptacles with water using a dropper. Excise caution not to moisten other parts of the coupon.

8.3 Transfer the coupon to the scale and record the weight of the coupon with the filled receptacles.

8.4 Using a ruler, measure the distance between the centers of adjacent receptacles along the width and length of the coupon.

NOTE 1—This measurement methods assumes that the receptacles are arranged in a rectangular pattern

8.5 Repeat the test after filling the coupon on inclined surfaces. The test should be completed for the following inclinations:

8.5.1 2 degrees (3.5 %),

8.5.2 5 degrees (8.7 %),

8.5.3 10 degrees (17.6 %), and

8.5.4 20 degrees (36.4 %).

8.6 Form a fence around the margin of the coupon using the metal strip material. As necessary, seal the edge of the fence using an elastomeric sealant complying with Specification C920. Allow the sealant to cure. Using the ruler, measure the inside dimensions of the fence.

8.7 Weigh the system and record.

8.8 Fill the geocomposite drain layer with coarse sand until the uppermost asperities are covered. Weigh and record.

8.9 Determined the unit weight, lb/ft^3 [kg/m^3], of the coarse sand.

9. Calculation of Results

9.1 Compute the unit media retention volume as follows:

$$Rm = 144 * Ws/(x\gamma * y)\ (\text{in.} - \text{lb}) \quad (1)$$

$$(Rm = 1 \times 10^6 * Ws/(x\gamma * y))\ (\text{SI})$$

where:

Rm = unit media retention volume, ft^3/ft^2 [cm^3/cm^2],
Ws = weight of system filled with sand minus weight of system without sand, lb [kg],
x = width fence, in. [cm],
y = length fence, in. [cm], and
γ = unit weight of sand, lb/ft^3 [kg/m^3].

9.2 Compute the unit water capture volume as follows:

$$Rw = (2.31 * Ww)/(N * X * Y)\ (\text{in.} - \text{lb}) \quad (2)$$

$$(Rw = (1 \times 10^3 * Ww) / (N * X * Y))\ (\text{SI})$$

$$Rf = 0.25 * Rw;$$

where:

Rw = unit water capture volume, ft^3/ft^2 [cm^3/cm^2],
Rf = unit water capture volume, when in-filled with media, ft^3/ft^2 [cm^3/cm^2],
Ww = weight of coupon filled with water minus weight of coupon dry, lb [kg],
N = number of receptacles on the coupon,
X = receptacle spacing along the width of the coupon, in. [cm], and

Y = receptacle spacing along the length of the coupon, in. [cm].

9.3 Conduct all tests in duplicate. If the results of two tests differ by more than 5 %, then repeat.

10. Report

10.1 Report the following information:

10.1.1 Product designation,

10.1.2 Size of the coupon tested,

10.1.3 Number of receptacles included on the coupon,

10.1.4 Unit media retention volume, and

10.1.5 Unit water capture volume, both *Rw* and *Rf* for the five inclinations.

11. Precision and Bias

11.1 *Precision*—The precision of the procedure for these test methods for measuring the media retention and water capture capacity of geocomposite drain layers is being determined. Parties interested in participating in interlaboratory test programs should contact Committee E60.

11.2 *Bias*—The bias for these measurements is undetermined because there are no reference values available for the materials used.

12. Keywords

12.1 geocomposite drain layers; media retention; vegetative (green) roof; water capture