Designation: D5993 – 14

Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners[1]

This standard is issued under the fixed designation D5993; 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 laboratory determination of the mass per unit area of a sample of a geosynthetic clay liner (GCL). The test method is also applicable to a multicomponent GCL. The dry mass of the clay can be found by simply subtracting the manufacturer's reported nominal mass of the geosynthetic component(s) from the total mass of the dry GCL. The moisture content of the GCL can also be determined by subtracting the initial total mass of the GCL from the total mass of the dry GCL.

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

1.3 *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.* See Section 8 for specific precautionary statements.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D4439 Terminology for Geosynthetics

D4643 Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:*

3.1.1 *geosynthetic, n*—a planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure, or system. **D4439**

3.1.2 *geosynthetic clay liner, n*—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetic material(s).

3.1.3 *moisture content, n*—that part of the mass of a geosynthetic clay liner that is absorbed water, compared to the mass of dry clay.

3.1.4 *multicomponent GCL, n*—GCL with an attached film, coating, or membrane decreasing the hydraulic conductivity or protecting the clay core, or both.

3.1.5 *oven-dried, adj*—the condition of a material that has been heated under prescribed conditions of temperature and humidity until there is no further significant change in its mass. **D123**

4. Summary of Test Method

4.1 The mass per unit area is determined by weighing (oven-dried) specimens of known initial size after drying in an oven over a sufficient time period to remove the moisture from the GCL.

4.2 The mass per unit area of the clay component of the GCL can be estimated by subtracting the manufacturer's reported nominal mass per unit area of the synthetic component(s) from the total GCL mass per unit area.

NOTE 1—The supplier of the geosynthetic clay liner must be able to verify that the actual mass/unit area of the synthetic component(s) is within ±10 % of the reported nominal value. A more accurate estimation of the actual dry clay mass per unit area could be obtained by using the actual average value for the synthetic component(s) (as obtained from the manufacturer for the actual lots used to make the GCL) rather than the nominal value.

4.3 The moisture content of the GCL can be estimated with this test method.

5. Significance and Use

5.1 This test method is used to determine if the GCL material meets specifications for mass per unit area at approximately 0 % moisture content, by oven-drying. It can be used as

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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.

an index test for quality control or quality assurance to determine specimen conformance.

6. Atmosphere Conditions

6.1 *Atmospheric Conditions:*

6.1.1 The atmospheric conditions of the laboratory performing mass per unit area of GCLs shall be: relative humidity of ≤ 70 % and temperature of 23 ± 4°C.

7. Apparatus

7.1 *Drying Oven*—Thermostatically-controlled, preferably of the forced-draft type, meeting the requirements of Specification E145 and capable of maintaining a uniform temperature of 110 ± 5°C throughout the drying chamber.

7.2 *Microwave Oven*—A microwave oven, preferably with a vented chamber, is suitable. The required size and power rating of the oven is dependent on its intended use. Ovens with variable power controls and input power ratings of about 700 W have been found to be adequate for this use. Variable power controls are important and reduce the potential for over heating the test specimen.

NOTE 2—Microwave ovens equipped with built-in scales and computer controls have been developed for use in drying soils. Their use is compatible with this test method.

7.3 *Balances*—All balances must meet the requirements of Specification D4753 and this section. A Class GP1 balance of 0.01 g readability is required for samples having a mass of up to 200 g (excluding mass of sample container) and a Class GP2 balance of 0.1 g readability is required for samples having a mass over 200 g.

7.4 *Sample Containers*—Suitable containers made of material resistant to corrosion and change in mass upon repeated heating, cooling, exposure to materials of varying pH, and cleaning. Microwave sample containers should be microwave safe.

7.5 *Desiccator*—A desiccator cabinet or large desiccator jar of suitable size containing indicator silica gel. It is preferable to use a desiccant that changes color to indicate it needs reconstitution.

7.6 *Container Handling Apparatus*—Gloves, tongs, or suitable holder for moving and handling hot containers after drying.

7.7 *Die,* of known dimensions.

7.8 *Miscellaneous,* knives, spatulas, scoops, quartering cloth, sample splitters, and so forth, as required.

8. Hazards/Precautions

8.1 Handle hot containers with a container holder.

8.2 Safety precautions supplied by the manufacturer of the microwave oven should be observed.

8.3 Do not use metallic containers in a microwave oven (if used).

9. Test Specimens

9.1 The sample received at the testing laboratory should be in satisfactory condition and representative of the product manufactured or delivered to a site, or both.

9.2 A sample of a GCL should be cut into specimens in a laboratory using a die or sharp razor blade or razor knife.

9.3 The minimum size of the die or template for cutting specimens is 0.01 m^2 (for example, 10 by 10 cm).

NOTE 3—The use of small specimens are not recommended due to the potential for edge loss of clay, which may create problems with accuracy and reproducibility.

9.4 Test specimens taken from the laboratory sample should be free from imperfections or other areas not representative of the material samples (such as dirt or labels).

9.5 Cutting of the laboratory specimens with a die or razor may contaminate the work area, die, or razor with particles of clay or geosynthetic material. The work area should be cleaned before cutting the specimen. Therefore, all excess or waste material should be cleaned away from the die and cutting area before removal of the specimen. The specimen, material on the die, and cutting area should be placed into a tared container. Wiping of the area should be performed with a non-clinging cloth or brush.

9.6 The loss of clay during the specimen cutting process could have a significant impact to the accuracy of this test method. The technician performing this test method should practice cutting test specimens from the laboratory sample until confidence is gained that a specimen can be cut without significant loss of clay.

9.6.1 The technician may choose to wet the perimeter of the GCL in an effort to bind the clay particles together and thereby reduce the possibility of clay granule loss during the cutting process. If the sample is wetted, the technician should try to limit the amount of clay that will attach itself to the die, cutting board, template, or cutting instrument, or combination thereof. However, if the technician attempting to determine the moisture content of the GCL, other cutting methods should be used that do not require the addition of water.

9.6.2 If a die is used to cut the specimen, loss of clay can be reduced by leaving the die in place and removing all the remaining sample outside the edge of the die. This includes brushing the cutting board clean. All material found within the edge of the die could then be placed in the sample containers.

9.6.3 Any waste clay left on the cutting board and die or razor for which the technician cannot determine if the clay came from the individual specimen or the original sample should be collected and weighed. It should be assumed the waste clay is edge loss from the individual specimen and the original sample. One half the weight of the waste clay should be added to the test specimen container and the other one-half discarded.

9.7 The number of test specimens should be a minimum of five, cut such that they are representative of the entire roll width.

10. Conditioning

10.1 Bring the test specimens to moisture equilibrium in the atmosphere for testing GCLs. Equilibrium is considered to have been reached when the increase in mass of the test specimen in successive weighing, made at intervals of not less than 2 h, does not exceed 0.1 % of the previous mass of the test