Designation: D8199 – 20

Standard Test Method for Determining the Specific Strength of Hydraulically Applied Fiber Matrix Products for Erosion Control[1]

This standard is issued under the fixed designation D8199; 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 standard provides a quantitative test method to determine the specific strength of hydraulically applied fiber matrix products using dry and wet preparation methods in a laboratory setting. This method is designed for use as an index test for product quality assurance or quality control, or both to comply with manufacturing requirements. This test method is not indicative of product performance in the field.

1.2 *Units*—The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided for information only and are not considered standard. Reporting of test results in units other than SI shall not be regarded as nonconformance with this standard.

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this test method.

1.3.1 The procedures used to specify how data are collected/recorded and calculated in the standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analysis methods for engineering data.

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]

D76/D76M Specification for Tensile Testing Machines for Textiles

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

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

D6026 Practice for Using Significant Digits in Geotechnical Data

D7986 Practice for Preparing Specimens of Hydraulic Erosion Control Products for Index Property Testing

3. Terminology

3.1 *Definitions:*

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *fiber matrix product, n—in erosion control*, hydraulically applied product providing enhanced and extended erosion control protection.

4. Summary of Test Method

4.1 Ten specimens are prepared from a representative sample in accordance with Practice D7986. Five specimens are then tested in the dry condition and five are tested in the wet condition. Each test specimen is clamped in a Constant Rate of Extension (CRE) tensile testing machine and a force is applied to the specimen until it breaks.

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.25 on Erosion and Sediment Control Technology.

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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.

*A Summary of Changes section appears at the end of this standard

4.2 The specific strength is calculated for each specimen as is the average specific strength of the five specimens tested in the dry and wet conditions.

5. Significance and Use

5.1 Specific strength is a measure of the ability of a fiber matrix product to withstand force applied by a tensile machine and is useful to understand in order to produce quality products. Specific strength is frequently related to the matrix density, fiber quality, fiber length and chemistry and can be used as a measurement for quality assurance or quality control, or both requirements.

5.2 This method may not be applicable to all hydraulically applied fiber matrix products due to variations in product chemistry.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Constant Rate of Extension (CRE) Type Tensile Testing Machine*—A device conforming to Specification D76/D76M and designed for operation at a speed of 300 ± 10 mm/min (12 ± 0.5 in./min).

6.2 *Measuring Devices*—CRE-type machines shall be equipped with a suitable device for measuring the force, and when needed, a device to measure extension. These devices shall conform to Specification D76/D76M.

6.3 *Clamping Devices*—The clamping devices shall conform to Specification D76/D76M with the following specific properties. The jaw faces shall be smooth, flat, and have a metallic surface. The jaw faces shall be parallel and have machining centers with respect to one another in the same clamp and to the corresponding jaw face of the other clamp. The jaw faces shall measure at least 10 mm (0.5 in.) wider than the specimen being tested and at least 25 mm (1.0 in.) in height.

6.4 *Balance*—Balances shall conform to the requirements of Guide D4753.

6.4.1 To determine the mass of the specimen, the balance shall have readability without estimation of 0.01 g. The capacity of this balance will need to exceed the mass of the container plus a specimen. In general, a balance with minimum capacity of 600 g is sufficient.

6.5 *Soaking Container*—An aluminum, or equivalent inert container with enough capacity to hold five specimens and test water. In general, a container with minimum dimensions of 100 by 200 by 60 mm (4 by 8 by 2.4 in.) is typically sufficient.

6.6 *Miscellaneous Items*—Items such as wooden sticks, glass rods, spatulas, containers with tight fitting lids, paper towels, and polystyrene foam plates may be useful.

7. Reagents

7.1 *Test Water*—Distilled, demineralized, or deionized water is the only permissible test fluid. The use of tap water is not permitted.

8. Hazards

8.1 *Safety Hazards*—Fiber matrix products can be dusty. It is recommended that eye protection and a dust mask be worn during sampling and testing.

9. Sampling and Preparation of Test Specimens

9.1 Follow the procedure given in Practice D7986 to obtain a representative sample of the material and then prepare 10 specimens having minimum dimensions of 100 by 130 mm (4 by 5 in.) in size.

NOTE 2—It may be worthwhile to prepare more than 10 specimens in case extras are needed during testing.

9.2 *Dry Preparation*—Select 5 of the test specimens and allow them to equilibrate to the test temperature range of 21 ± 2°C (70 ± 4°F) and the relative humidity range of 40 ± 10 %. Proceed to Section 10.

9.3 *Wet Preparation*—Fill the soaking container with test water and soak five test specimens for 30 minutes. Use a clean, wooden stick, spatula, or glass rod to hold the test specimens down in the test water for about five seconds until the test specimens are fully hydrated and submerged in the test water.

9.3.1 While the specimens are soaking, cover a disposable, polystyrene foam plate with a paper towel. After 30 minutes of soaking, place the test specimens on the paper towel-covered plate and cover the specimens with another paper towel and plate to create a "sandwich." Flip plates over and remove the top plate, replace the wet paper towel, and repeat this process for a total of 20 times.

9.3.2 Remove the test specimens from the plate and immediately proceed to Section 10. If testing cannot occur within 5 minutes, place the test specimens in a tightly covered container to prevent water content changes.

10. Procedure

10.1 Begin with wet specimens first. Work quickly to reduce the potential for changes in the water content.

10.2 Determine and record the mass of each specimen, M_s, to the nearest 0.01 g.

10.3 Set the gage length to 75 mm (3 in.).

10.4 Mount the test specimen securely in the clamp of the testing machine with the 130 mm (5 in.) side vertically. Take care that the test specimen is centrally located and that the long dimension is as parallel as possible to the direction of force application. Make sure the tension on the specimen is uniform across the clamped width. Clamps which are too tight will produce breaks at the clamp line; clamps which are too loose will cause slippage.

10.5 After mounting the test specimen, zero the force (and gage) indicators as applicable and set the rate of extension to 300 ± 10 mm/min. (12 ± 0.5 in./min). Follow the tensile testing machine's manufacturer's instructions to begin the test.

Once the specimen has failed, read and record the force, *P*, at failure to the nearest 0.1 N (0.1 lbf).

10.6 If a specimen slips in the jaws, or breaks at the edge of, or in the jaws record the test result and indicate on the data sheet the issue and if applicable, the break location (Note 3).

NOTE 3—The average specific strength of the group is not calculated until after all five specimens have been tested; however, it's possible to assess the likelihood that an individual result may be more than 50% below of the calculated average. In this case, it may be prudent to test an additional specimen at this time instead of waiting to confirm the results acceptability.

10.7 Repeat 10.1 through 10.5 until five specimens have been tested in both the wet and dry conditions.

11. Calculation or Interpretation of Results

11.1 Calculate the specific strength, σ, for each specimen tested using the following equation:

$$\sigma = \frac{P}{M_s} \tag{1}$$

where:

σ = specific strength, nearest 1 N/g,
P = force at failure, nearest 1 N, and
M_s = mass of specimen, nearest 0.01 g.

11.2 Calculate the average specific strength of the five specimens tested in the dry condition, σ_{davg}, and also calculate the average specific strength of the five specimens tested in the wet condition, σ_{wavg}.

11.3 If any of the individual specimen results are 50 % or more below the calculated average of the group to which it belongs, record the result, indicate it is not acceptable, and test another specimen. If the new test result is acceptable, recalculate the average for the group. If not, continue retesting until the results of the individual tests are acceptable. Record all test results regardless of whether they were acceptable or unacceptable.

12. Report: Test Data Sheet(s)/Form(s)

12.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s), as given below, is covered in 1.3 and in Practice D6026.

12.2 Record as a minimum the following general information (data):

12.2.1 Identification of the material being tested, such as the product name, lot number, or sample number and supplier name.

12.2.2 Test specimen number/identification and testing dates and the initials of the person(s) who performed the test.

12.2.3 Describe the product, including the labeling information obtained from the original sample, and method of sampling.

12.2.4 Record the apparatus identification number for the equipment used during testing and preparation: the testing tensile machine, the measuring device, and the balance(s).

12.2.5 The type of clamp used and the size of the jaw faces to the nearest 10 mm (0.5 in.).

12.3 Record as a minimum the following test specimen data:

12.3.1 The preparation method for each specimen, dry or wet, and include reference to Practice D7986.

12.3.2 The mass of each specimen, M_s.

12.3.3 The force at failure, *P*.

12.3.4 Slipping from jaws or breaks at the edge or in the jaw, as applicable.

12.3.5 The calculated specific strength of each specimen tested regardless of whether or not the result was acceptable or used in calculations. Indicate results that were not acceptable and indicate which results were used in the average specific strength calculation.

12.3.6 The calculated average specific strength of acceptable specimens tested in both the dry and wet conditions.

13. Precision and Bias

13.1 *Precision*—Test data on precision is not presented due to the nature of the fiber matrix materials tested by this test method. It is either not feasible or too costly at this time to have ten or more laboratories participate in a round robin testing program.

13.1.1 Subcommittee D18.25 is seeking any data from users of this test method that might be used to make a limited statement on precision.

13.2 *Bias*—There is no accepted reference value for this test method, therefore, bias cannot be determined.

14. Keywords

14.1 breaking strength; erosion control; hydraulically applied fiber matrix products; specific strength; tensile