Designation: D7880/D7880M – 13

Standard Test Method for Determining Flow Rate of Water and Suspended Solids Retention from a Closed Geosynthetic Bag[1]

This standard is issued under the fixed designation ; 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 is used to determine the flow rate of water and suspended solids through a geosynthetic permeable closed bag used to contain high water content slurry such as dredged material.

1.2 The results for the water and sediment that pass through the geotextile bag are shown as liters of water per time period, and the percent total suspended solids in milligrams per liter or parts per million.

1.3 The flow rate is the average rate of passage of a quantity of solids and water through the bag over a specific time period.

1.4 This test method requires several pieces of specified equipment such as an integrated water sampler, analytical balance, geotextile bag, stand clear PVC pipes, testing frame, and clean containers to collect the decant water and a representative sample of high water content material from the proposed dredge area or slurry source.

1.5 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.

1.6 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D4354 Practice for Sampling of Geosynthetics and Rolled Erosion Control Products(RECPs) for Testing

D4439 Terminology for Geosynthetics

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of other terms relating to geosynthetics, refer to Terminology D4439.

3.1.2 For definitions of textile terms, refer to Terminology D123.

3.1.3 For definitions of soil terms, refer to Terminology D653.

3.1.4 *high water content material, n*—a slurry of water and solids exhibiting the properties of a liquid, typically having a percent solids by weight smaller than 50 % (water content greater than 100 %), and the size of the solid particles tend to be very fine grained (<0.064 mm).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *flow rate, n*—volume of fluid per unit time, expressed as an average, that passes through a geotextile hanging bag.

3.2.2 *geotextile hanging bag, n*—bag, tube, sock, or container designed and fabricated from a single or a combination of layers of permeable geosynthetic to retain finegrained particles such as found in dredged material, for subsequent dewatering of the contained semi fluid materials.

4. Summary of Test Method

4.1 A geotextile bag is constructed by sewing one or more layers of geotextiles together to form a closed container with an entry clear PVC pipe providing entry to the bag. The bag will support and contain a measured amount of saturated dredged material or other high water content material.

4.2 The amount of water and sediment that flows through the geotextile container is collected at given time intervals and measured. The amount of sediment passing the geotextile container is determined as the total suspended solids.

4.3 Use material from the designated area to be dredged at the estimated initial percent solids as the actual field conditions, or the source of the high water content material.

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[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.03 on Permeability and Filtration.

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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.

5. Significance and Use

5.1 This test method may be used as an aid to design geotextile container systems that contain fine-grained, high water content slurries such as dredged materials to meet special environmental or operational requirements. This test is often used to demonstrate the efficacy of geotextile dewatering to regulatory agencies in determining the amount of dredged material sediment passing through a geotextile and the flow rate for specific high water content materials.

5.2 The designer can use this test method to assess the quantity of fine-grained dredged material sediment that may pass through the geotextile container into the environment.

5.3 This test method is intended for evaluation of a specific material, as the results will depend on the specific high water content slurry and geotextile evaluated and the location of the geotextile container below or above water. It is recommended that the user or a design representative perform the test because geotextile manufacturers are not typically equipped to handle or test fine-grained slurries.

5.4 This test method provides a means of evaluating geotextile containers with different dredged materials or high water content materials under various conditions. The number of times this test is repeated depends on the users and the test conditions.

5.5 This test method may not simulate site conditions and the user is cautioned to carefully evaluate how the results are applied.

6. Apparatus

6.1 Frame. Shown in Fig. 1.

6.2 Geosynthetic Bag (container), unfilled bag dimensions shall be approximately 53 cm [21 in.] length × approximately 53 cm [21 in.] width to produce a filled bag capacity of 1 ft^3. Bag shall have all the sides sawed using the same stitch pattern and seam along the entire edge.

6.2.1 The Geosynthetic Bag (container) shall have a 50.8 mm [2.0 in.] diameter female adaptor coarse threaded PVC flange installed at the top side of the bag. The center of the adapter should be located at the center of the two transversal axis of the bag. Shown in Fig. 1.

6.3 Collection Container approximate capacity filled about 75 L [20 gal], suitable to capture filtrate and proportionately sized to allow placement under the testing frame. Shown in Fig. 1.

6.4 "Stand" Pipe made from 50.8 mm [2.0 in.] diameter and at least 1.10 m [43.30 in.] in length clear PVC or other suitable plastic. "Stand" Pipe shall include a threaded male adapter to facilitate connection the female PVC flange.

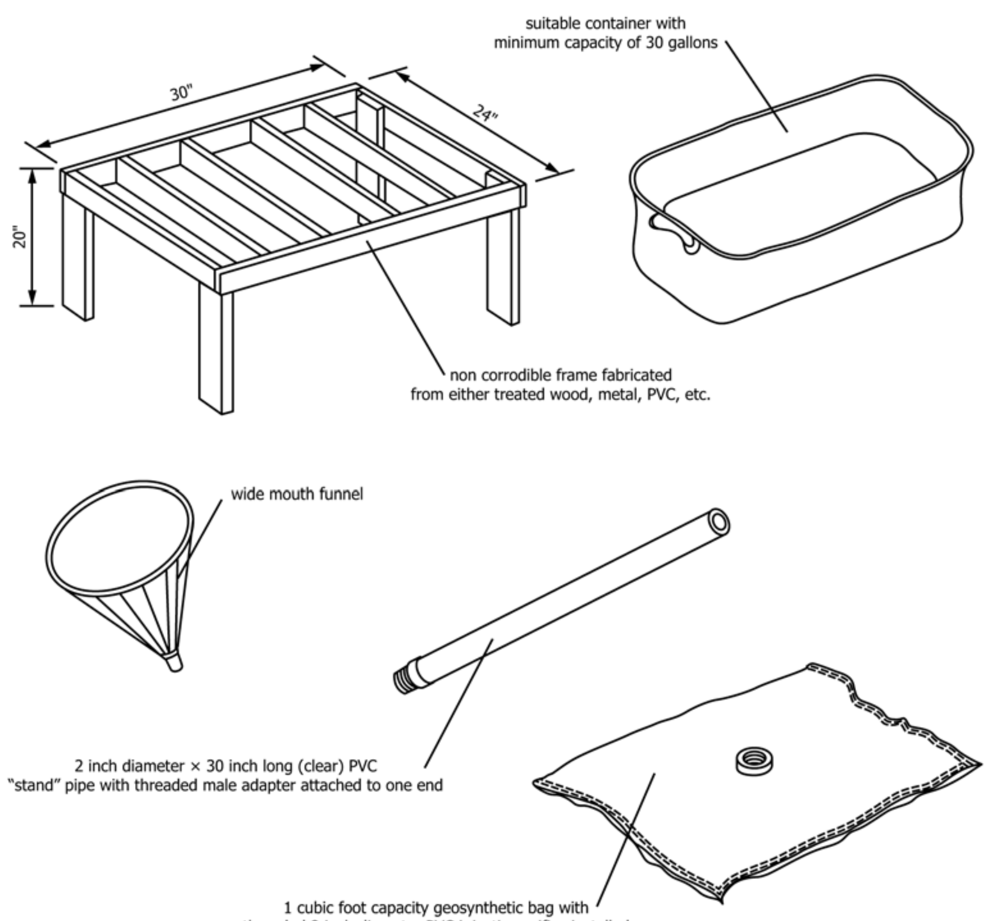

FIG. 1 Test Equipment, Bag and Frame

6.5 Funnel.

6.6 Integrated Water Sampler, a 0.5-L [0.13-gal] device used to collect integrated samples of water.

6.7 Stopwatch.

6.8 Stirrer, such as a stirring rod on a portable electric drill.

6.9 Dredged Material, from the proposed dredge area.

6.10 Gooch Crucible.

6.11 Membrane Filter Apparatus.

6.12 Vacuum Pump.

7. Sampling

7.1 *Geotextile Container:*

7.1.1 *Lot Sample for Geotextile Container*—Divide the product into lots and take the lot samples as directed in Practice D4354.

7.1.2 *Geotextile Container Sample*—After first discarding a minimum of 1 m [3.3 ft] of geotextile from the end of the roll, cut sufficient lengths to fabricate the number of containers for the appropriate number of tests. If holes or damaged areas are evident, then damaged areas should be discarded and additional material used. No fabric should be used within 0.2 m [6 in.] of a selvedge edge.

7.2 *Dredged Material or High Water Content Material*—Obtain representative samples significant to the design of geotextile containers. The size and number of samples required is dependent upon the number of tests to be performed. Samples should be representative of the wet bulk density, water content, and consistency obtained from the dredge, pump, or other source to be placed in the geotextile tube for dewatering. In some cases, this may mean adding source water to replicate field conditions.

8. Procedure

8.1 When appropriate, pre-wet the geotextile container by soaking the geotextile in prefiltered water from the proposed dredge area until fabric is fully soaked and saturated. Do not use distilled de-ionized or water from any other source.

8.2 Place the geotextile container on top of the frame capable of safely holding 50 lb. There should be a clearance of about 20 cm [8 in.] for the bottom of the container above the floor of the platform to accommodate removal of the collection pans as they fill with sediment and water. Insert and secure the clear stand pipe in the threaded adaptor.

8.3 After the soaked geotextile container has drained of free water, place a dry shallow collector pan as described in 6.3 under the geotextile container to collect water and sediment by gravity flow.

8.4 Collect approximately 55 to 95 L [15 to 25 gal] of sludge into a suitable container and mix to ensure uniformity.

NOTE 1—A larger sample of sludge may be required if a low percentage of solids is present.

8.5 Assemble the testing frame if necessary and place a suitable collection container or under the frame to catch the effluent during testing.

8.6 Fill the geosynthetic bag by pouring the sludge into the top of the "stand" pipe. A smaller bucket and funnel can be utilized to facilitate this process. The "stand" pipe should be lifted off of the bottom of the geosynthetic bag; otherwise, the introduced sludge may back up in the pipe and overflow. This should no longer be of concern once the test bag has accumulated some volume of sludge.

8.7 Fill the geosynthetic bag with sludge as rapidly as possible until the sludge rises in the "stand" pipe to a pre-determined height corresponding to an agreed head pressure.

8.8 Collect effluent samples from the bag. The effluent should be examined for clarity and samples may be taken for testing.

8.9 If samples are to be collected for testing, carefully place the water sample with all visible sediment in approved clean glass containers marked with the time, quantity, and order in which they were collected and recorded. A stopwatch should be utilized to determine the elapsed time that each sample was collected.

8.10 Empty the collection container and collect the water and sediment for sampling in approved clean glass containers marked with the time, quantity, and order in which they were collected and recorded.

8.11 Continue to collect the water and sediment for sampling from the collection container for about one week or until drainage has slowed to less than a 25.4-mm [1-in.] depth in the container per 24 h. This completes the filtrate sample collection phase of the test.

8.12 At the completion of the sample collection, agitate the collected filtrate in each of the glass containers with a stirrer until the mixture is uniformly mixed, After 1 min of mixing, obtain a depth-integrated suspended solids sample from the mixture while continuing the agitation.

NOTE 2—With the sampler specified in 6.3, a rate of sampling that requires 30 s to reach the bottom of the container and 30 s to return to the surface is ideal. This sampling procedure allows collection of a sample over the full depth of the mixture.

8.13 Place a pre-weighted filter disk either on a membrane filter apparatus or in the bottom of a suitable Gooch crucible. Apply a vacuum and wash the disk with three successive 20-mL portion of distilled water. Continue suction to remove all traces of water from the disk.

8.14 Carefully remove the filter disk from the membrane filter apparatus and transfer to an aluminum or stainless steel planchet. If a Gooch crucible is used, remove the crucible and filter disk combination.

8.15 Dry the filter disk for at least 1 h in an oven at 104°C ± 1°C.

8.16 Store in a desiccator until cooled to room temperature.

9. Calculation

9.1 Calculate total suspended solids:

$$s_S = \frac{(A - B) \times 1000}{C} \quad (1)$$

where:

S_s = suspended solids, ppm;
A = weight of dry filter plus dry residue;
B = weight of dry filter; and
C = sample volume of suspended material, millilitres.

9.2 Calculate the flow rate, F_{DM}, of the dredged material sediment and water for each sample collected for the geotextile container using Eq 2:

$$F_{DM} = \frac{Q_P}{t_p} \tag{2}$$

where:

Q_P = quantity of dredged material sediment and water collected in the aluminum pans for each sample.
t_p = time is measured in minutes for each sample collected.

9.2.1 Correct the flow rate to 20°C using Eq 3:

$$F_{20°C} = \frac{F_{DM}U_T}{U_{20°C}} \tag{3}$$

where:

U_T = ratio of viscosity of water at temperature T to viscosity of water at 20°C (see Fig. 2).

10. Report

10.1 In the report of total suspended solids and flow rate, include the following information:

10.1.1 State that the specimens were tested as directed in this test method. Describe the type of geotextile and seam tested and the sampling method used.

10.1.2 Report the number of specimens tested and the direction(s) tested (if applicable).

10.1.3 Report the type of dredged material, initial volume, weight, and height of material used and any data showing pertinent physical properties of the dredged material soil.

10.1.4 Report mass of sediment collected in pan.

10.1.5 Report complete test data including temperature of the water, recorded flow rates, length of test, and suspended solids content for each dredged material and water sample collected and total average values for all tests.

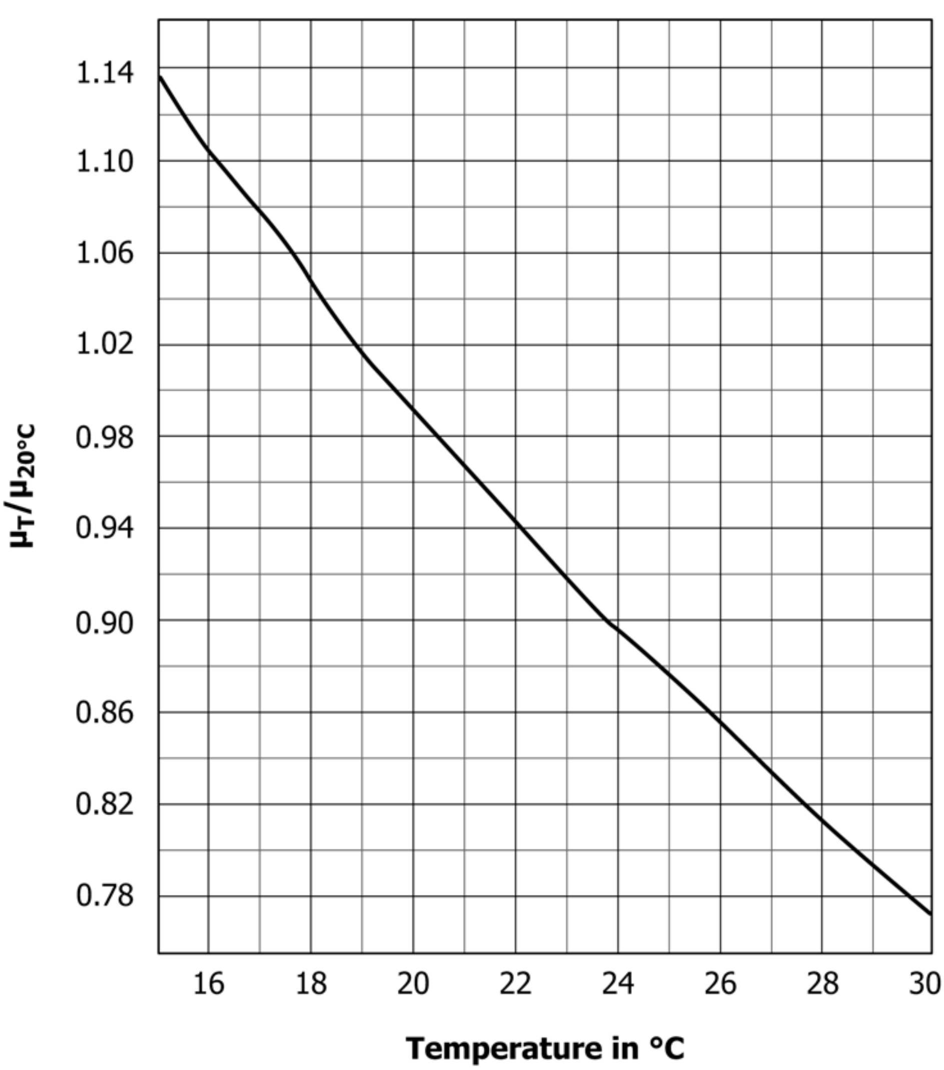

FIG. 2 Flow Rate to 20°C

10.1.6 Give a statement of any deviation from the described test method.

11. Precision and Bias

11.1 *Precision*—The precision of the procedure in this test method for measuring suspended solids and flow rates for geotextile containers for dredged material containment systems will be established within five years.

11.2 *Bias*—The procedure in this test method for measuring suspended solids and flow rate of a geotextile container system may be biased because of different geotextile container geometries, container surface area, container volume, type of dredged material, or whether the container is submerged or not submerged. The test method described is simply an index test to determine the relative difference in flow rate and suspended solids with the use of various geotextile systems and various types of dredged materials. The sediments determined for submerged containers would be much less than for non-submerged containers because the pressure gradient and flow rate is very small for submerged containers and is caused only by the slow release of pore water pressure during sedimentation and consolidation of the dredged material.

12. Keywords

12.1 contaminated dredged materials; dredged materials; flow rates; geotextile containers; suspended solids