Designation: D7701 – 11

Standard Test Method for Determining the Flow Rate of Water and Suspended Solids from a Geotextile Bag[1]

This standard is issued under the fixed designation D7701; 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 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 container, frame to hold the geotextile container, 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 SI units are to be regarded as the standard. The values in parentheses are provided for information only.

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

D4759 Practice for Determining the Specification Conformance of 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 fine-grained 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 container that will support and contain a measured amount of saturated dredged material or other high water content material.

4.1.1 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.

4.2 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.

[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 Test A

6.1 *Wooden Frame*, shown in Fig. 1.

6.2 *Geotextile Container*, with eight evenly spaced metal grommets, 1.52m (5 feet) circumference, 165-cm (65-in.), approximate capacity filled is about 75 L (40 gal), shown in Fig. 2.

6.3 Three shallow 8-cm (3-in.) deep, 61-cm (24-in.) diameter aluminum pan (hot-water heater drip pan) shown in Fig. 1.

6.4 *Integrated Water Sampler*, a 0.5-L (0.13-gal) device used to collect integrated samples of water.

6.5 Two large 208-L (55-gal) containers for dredged material when required.

6.6 *Stopwatch.*

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

6.8 *Dredged Material*, from the proposed dredge area.

6.9 *Crucible*.

6.10 *Membrane Filter Apparatus.*

6.11 *Vacuum Pump.*

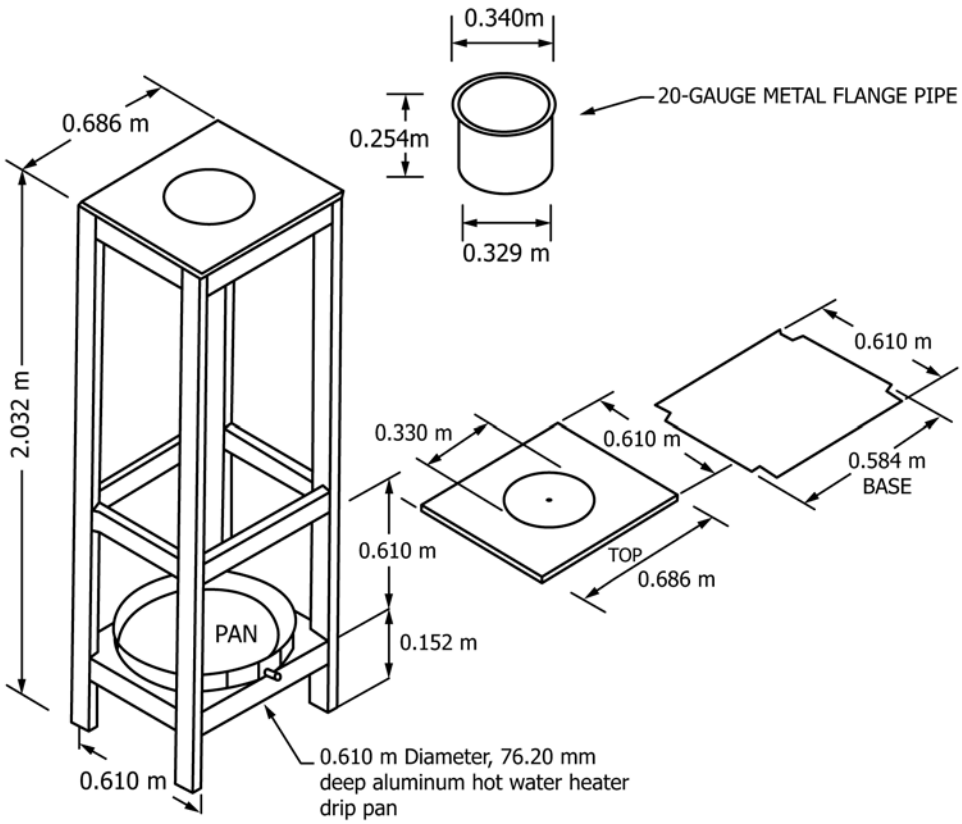

FIG. 1 Procedure A

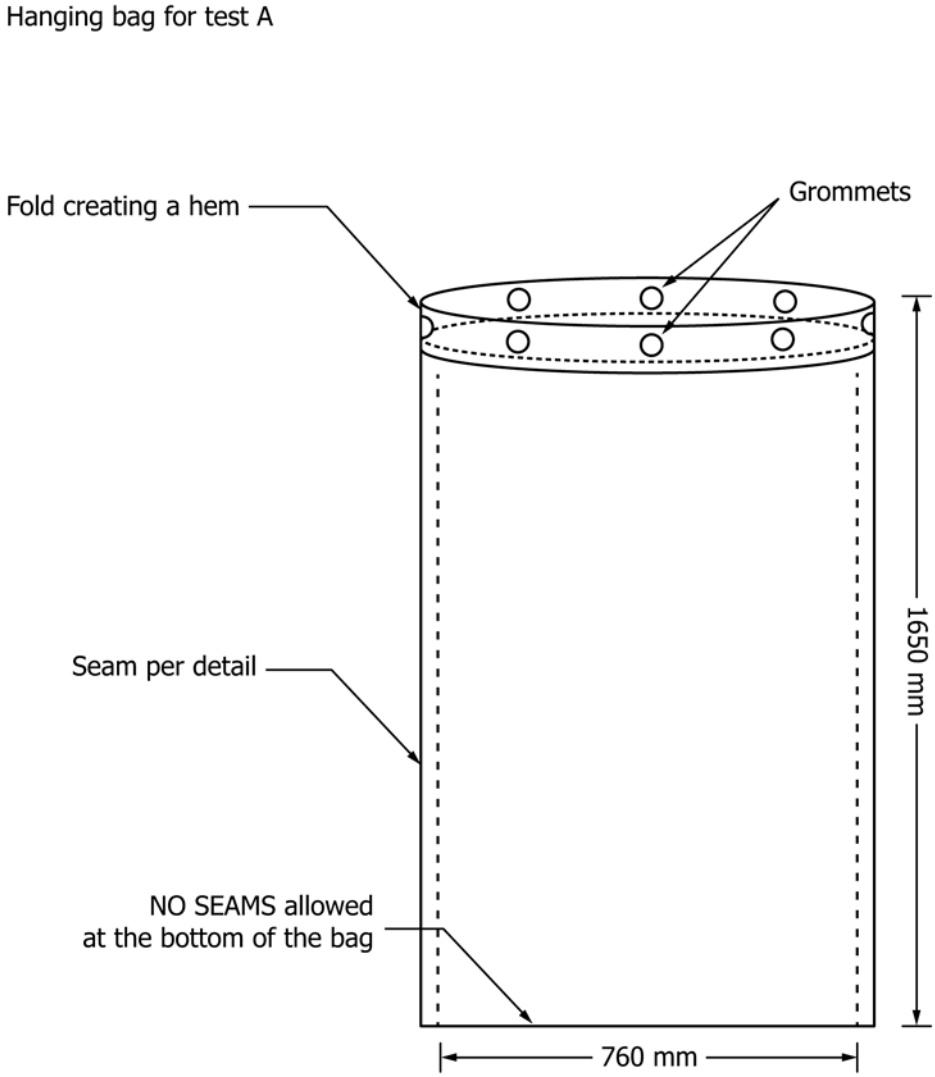

FIG. 2 Hanging bag for procedure A

6.12 Sediment-Free Water, prepared from water obtained from the proposed dredged area to soak geotextile containers. Do not use distilled de-ionized or water from any other source.

7. Apparatus Test B

7.1 *Geotextile Container*, with four evenly spaced fabric straps, 0.92m (3.0 feet) deep and 1.52m (5 feet) circumference shown in Fig. 3.

7.2 Two 15.2 cm (6 in.) deep, 41.9 cm (16.5 in.) wide and 88.3cm (34.75 in.) long clear plastic pan shown in Fig. 3.

7.3 1000 mL graduated beaker used to collect and measure samples of water.

7.4 *Stopwatch.*

7.5 *Stirrer*, such as a paint mixing rod on a portable electric drill.

7.6 *Dredged Material,* from the proposed dredge area or high water content slurry from source, 19 Liters (5 U.S. gallons).

7.7 Sediment-Free Water, prepared from water obtained from the proposed dredged area to soak polyester geotextile containers. Do not use distilled de-ionized or water from any other source. Since polypropylene is hydrophobic, pre-soaking is not required.

8. Sampling

8.1 *Geotextile Container*

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

8.1.2 *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.

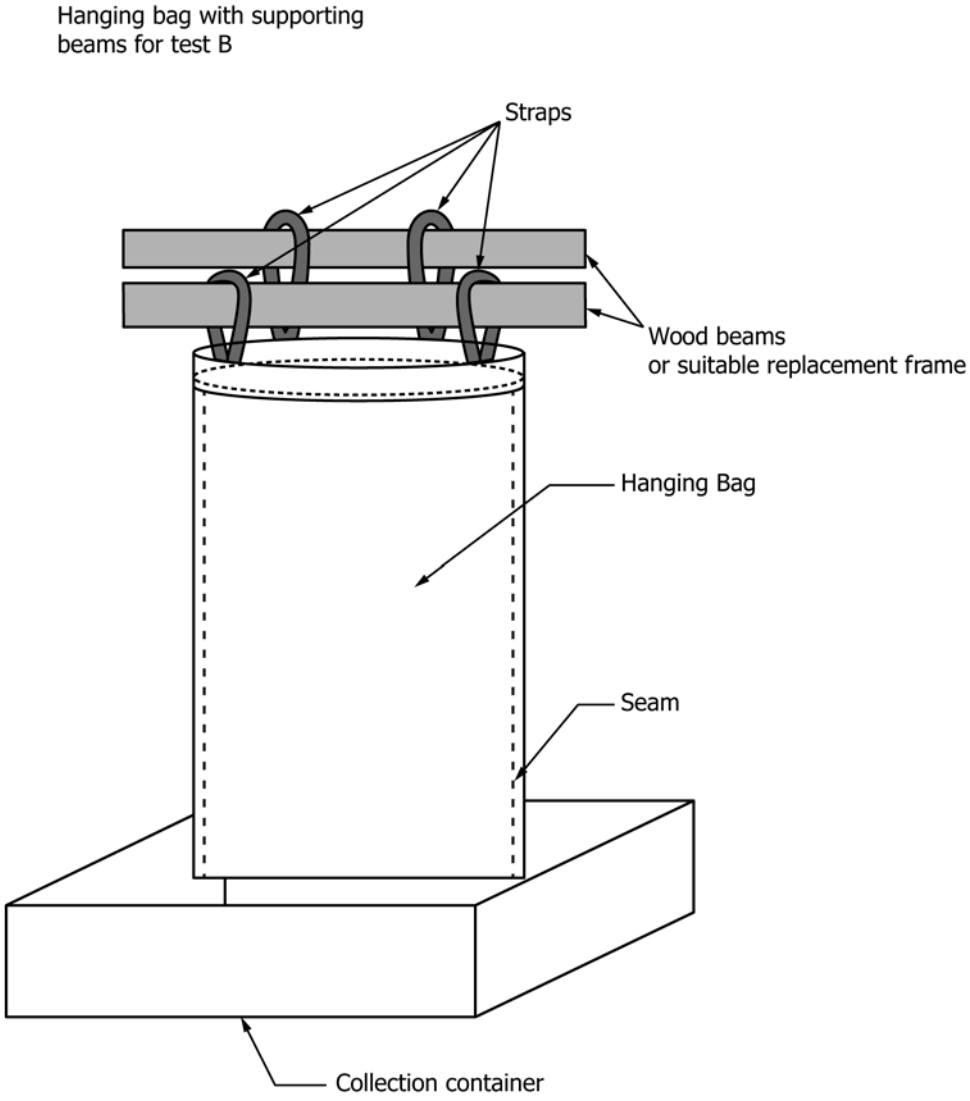

FIG. 3 Procedure B

8.2 *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.

9. Procedure

9.1 Geotextile containers provided by the manufacturer are constructed by sewing one or more geotextile layers of geotextile together to form a container. Test A containers shall be 114-cm (45-in.) inside circumference and 163 cm (64 in.) long as shown in Fig. 1. A hem edge is provided along the circumference of the container opening. Eight 1-cm (½-in.) diameter metal grommets are evenly spaced about 2.5 cm (1 in.) from the hem edge. Fabric seams are constructed by two double-lock stitches to contain the dredged material as it would be in the prototype. Test B containers shall be 0.92m (3.0 feet) deep and 1.52m (5 feet) circumference as shown in Fig. 4. Four evenly spaced straps are sewn to the top finished edge. Fabric "J" seams are constructed by two double-lock stitches along the sides of the bag. There should be no seam at the bottom of the bag.

9.2 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.

9.3 Attach the geotextile container to a frame or other apparatus capable of safely holding 50 pounds, or in the case of Test A, a sheet metal pipe with 1-cm (3/8-in.) galvanized bolts, washers, and nuts through the eight evenly spaced metal grommets as shown inFig. 1. There should be a clearance of

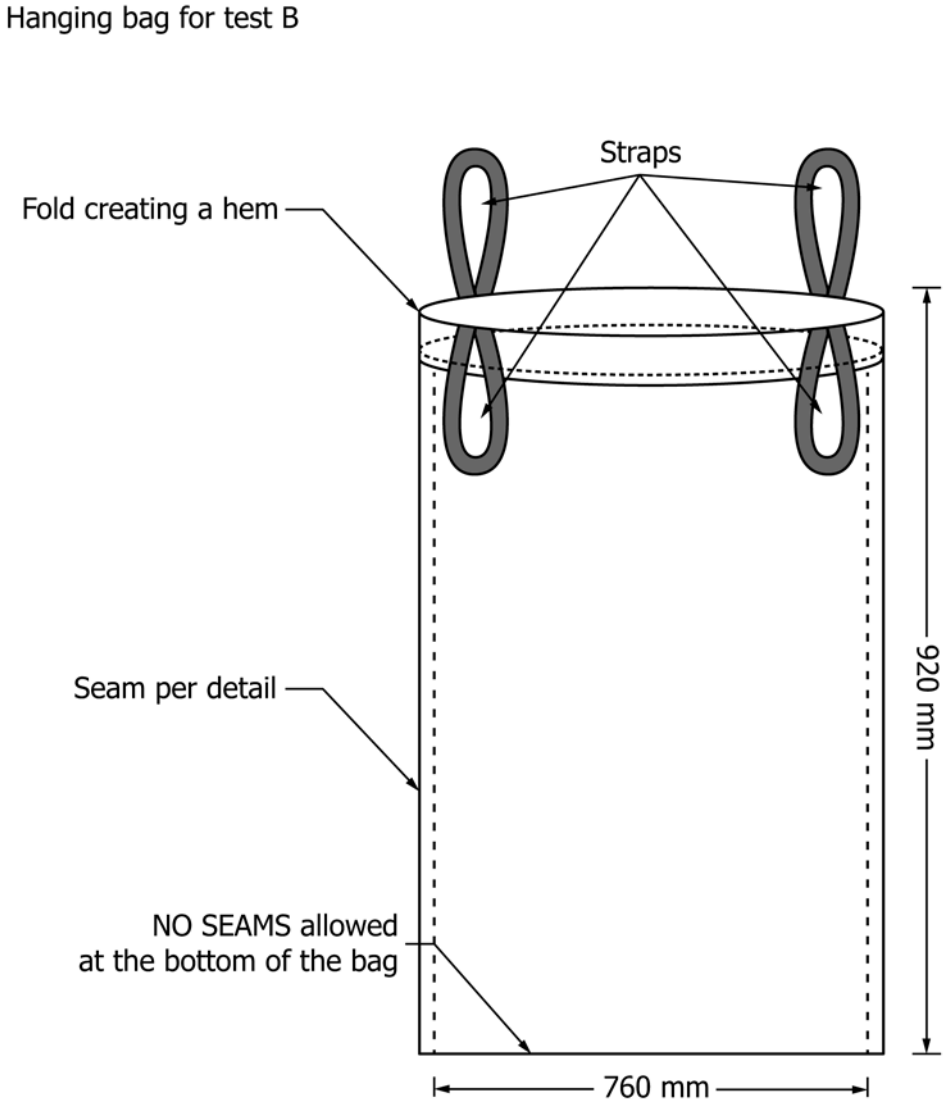

FIG. 4 Hanging bag for procedure B

about 20 cm (8 in.) for the bottom of the container above the floor of the platform to accommodate removal the collection pans as they fill with sediment and water.

9.4 After the soaked geotextile container has drained of free water, place a dry shallow collector pan as described in 6.3 and 7.2 under the geotextile container to collect water and sediment by gravity flow.

9.5 For Test A, obtain about 150 to 190 L (40 to 50 gal) of the site-specific dredged material in a 208-L (55-gal) container. Thoroughly agitate the dredged materials with the stirrer for 1 min to mix in free decant water to obtain a uniform consistency that would be representative of dredged material after excavation and placement. Immediately pour this mix through an adequate size funnel attached to the geotextile container and start the stopwatch simultaneously. For Test B, obtain approximately 19 L (5 gallons) of the site-specific high moisture content material. Thoroughly agitate as described above. Take a sample of the initial slurry for determination of percent solids by weight using a mud balance or by sending to a test laboratory. Pour the mixed slurry into the hanging bag and start the stopwatch.

9.6 For Test A, as the shallow aluminum pans fill about half full (about 11 L (3 gal)) with water and sediment, remove them and record the time and quantity. Carefully place the water and sediment sample with all visible sediment in approved clean glass containers marked with the time, quantity, and order in which they were collected and recorded. For Test B, remove the shallow container at predetermined time intervals, immediately replace with a clean container, measure the volume in the first container and record. A sample may be saved for later analysis. Typical time intervals would be 2, 5, 10, 15, 30, 45, 60 minutes followed by measurements at longer time intervals up to 24 hours and a maximum of 48 hours.

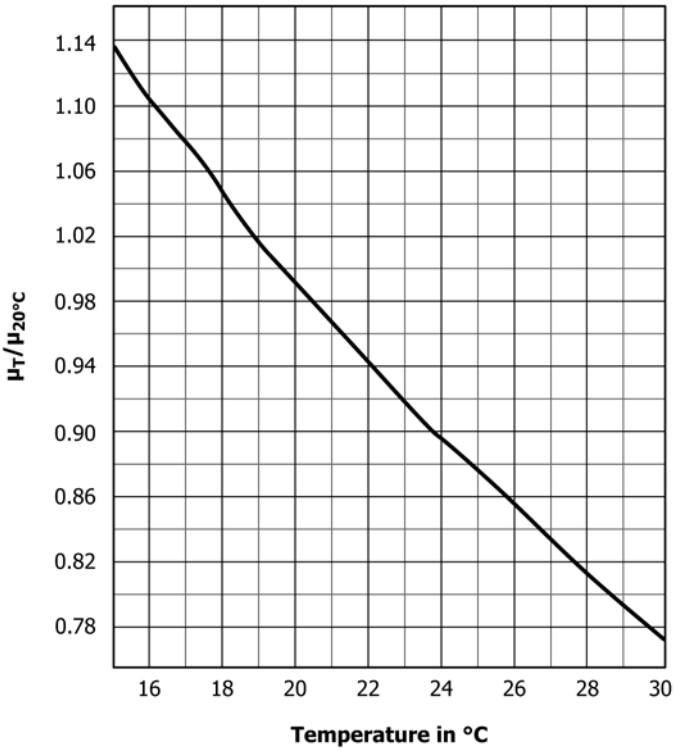

FIG. 5 Flow Rate to 20°C

9.7 For Test A, collect water and sediment from the drainage of the dredged material in the shallow aluminum pans until drainage has slowed to less than a 2.5-cm (1-in.) depth in the pan per 24 hours. This completes the filtrate sample collection phase of the test.

9.8 At the completion of the sample collection, agitate the collected filtrate in each container with a stirrer until the mixture is uniformly mixed, After 1 min of mixing, obtain a depthintegrated suspended solids sample from the mixture while continuing the agitation.

NOTE 1—With the sampler specified in 6.4, 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.

9.9 Place a pre-weighted filter disk either on a membrane filter apparatus or in the bottom of a suitable 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.

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

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

9.12 Store in a desiccator until cooled to room temperature.

9.13 Weigh the filter disk to an accuracy of 0.000 01 g.

9.14 Place the filter disk in the membrane filter apparatus and return it or the Gooch crucible to the vacuuming and filtering apparatus.

9.15 Under the vacuum, filter the sample of water collected in 9.7

9.16 Repeat 9.9 through 9.12

9.17 An alternative to the method described in paragraphs 8.8 through 8.16 is to take the decant water samples to a test laboratory for determination of Total Suspended Solids and chemistry testing if required.

9.18 At the end of the decant water collection period, a sample of the dewatered material retained within the geotextile bag can be obtained. Using a mud balance or other laboratory method, determine the final percent solids by weight of the retained material.

10. Calculation

10.1 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, milliliters.

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

$$F_{DM} = \frac{Q_P}{t_P} \quad (2)$$

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

$$F_{20°C} \frac{F_{DM} U_T}{U_{20°C}} \quad (3)$$

where:

U_T = ratio of viscosity of water at temperature T to viscosity of water at 20°C (see Fig. 5).

11. Report

11.1 State what procedure was employed.

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

11.2.1 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.

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

11.2.3 Report the type of dredged material, initial volume, weight, percent solids by weight, and height of material used and any data showing pertinent physical properties of the dredged material soil such as gradation and specific gravity.

11.2.4 Report mass of sediment collected in pans and the total water decanted during the test.

11.2.5 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.

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

12. Precision and Bias

12.1 *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.

12.2 *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 a performance 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 or high water content slurries.

13. Keywords

13.1 contaminated dredged material; dredged material; flow rate; geotextile container; high moisture content slurry; suspended solids