

SECTION 31 23 33.19

COMPOSITE BENTONITE AGGREGATE TRENCH DAMS AND ANTI-SEEP COLLARS

PART 1 GENERAL

1.01 SCOPE

The scope of work covered by this specification is for the installation of Composite Bentonite Aggregate (CBA) material for Trench Dams and Anti-Seep Collars as manufactured by AquaBlok or approved equal.

1.02 REFERENCES

A. ASTM International

1. C 29 Standard Test Method For Bulk Density ("Unit Weight") And Voids In Aggregate
2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
3. D 854 Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
4. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
5. D 2166 Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
6. D 2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
7. D 2435 Standard Test Method for One-Dimensional Consolidation Properties Of Soils
8. D 2488 Standard Practice or Description And Identification Of Soils (Visual-Manual Procedure)
9. D 2850 Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils
10. D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
11. D 4546 Standard Test Methods for One-Dimensional Swell or Collapse of Soils
12. D 4767 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
13. D 5084 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
14. D 5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners

1.03 SUBMITTALS

The Composite Bentonite Aggregate (CBA) manufacturer shall provide the Owner / Engineer with the following documentation prior to the beginning of construction:

- A. A certificate stating the name of the CBA manufacturer, product name, composition, and other pertinent information to fully describe the CBA.
- B. A copy of quality control certificates issued by the bentonite supplier that the bentonite meets the CBA specifications herein.

- C. Copies of bulk density and gradation analysis of the aggregate used in the CBA.
- D. A certificate of compliance that results from ASTM and AASHTO test methods listed above, performed by a laboratory approved by the manufacturer meet the specifications herein.
- E. Copies of Safety Data Sheets (SDS) pursuant to OSHA Hazard Communication Standard for each type of CBA to be used.
- F. One (1) bagged sample of material weighing no less than 16 ounces displaying the name of the CBA manufacturer, product name, and any other descriptive identifiers of the CBA.

1.04 QUALIFICATIONS

A. Manufacturer

1. The specified CBA shall be manufactured by:

- a. AquaBlok, Ltd.
175 Woodland Avenue
Swanton, OH 43558
(419) 825-1325
www.aquablok.com

- b. An approved equal - Contractor shall submit alternative equivalent product manufacturer documentation to Owner / Engineer for approval

2. Documentation as to performance and experience of a proposed alternative manufacturer of the CBA specified shall demonstrate at least five (5) years of continuous experience in the manufacture of such CBA, producing at least 2,000 tons of the specified CBA during said period with delivery, placement, and performance documentation for no less than 10 project applications.

1.05 LABELING, DELIVERY, STORAGE, AND HANDLING

A. Each package of CBA shall be delivered to the site with appropriate labeling, to include:

- 1. Product Identification (this may include the name of the manufacturer, product trade name, or other pertinent identifiers).
- 2. Batch / Lot or other Production Identification Number.
- 3. Weight of CBA contained in the package.

Any CBA package delivered to the site without all the labeling described above shall be rejected by the Owner / Engineer and /or installer.

B. Each package of CBA shall be delivered to the site by appropriate means to minimize damage to the packaging and material and to facilitate safe off-loading.

- C. Off-loading and storage of the CBA is the responsibility of the installer. Any package damage or loss of material during off-loading shall be immediately reported to the Owner / Engineer.
- D. All packages of CBA shall be stored in its original shipping package until installation. CBA can be stored outdoors by placing on pallets on ground that is not subject to ponding water. Outdoor CBA storage shall be tarped with complete coverage to protect from rainfall. It is recommended that CBA stored outdoors be used within six months of delivery to the site. Bulk package totes can be double stacked with approval from the Owner / Engineer.
- E. Labeling, delivery, storage and handling described in this section applies to individually packaged CBA. The manufacturer shall be contacted for specific recommendations regarding loose bulk (delivered without packaging).

1.06 QUALITY ASSURANCE / QUALITY CONTROL

- A. The CBA manufacturer shall provide the Owner / Engineer with its Manufacturing Quality Assurance / Quality Control Plan. This plan includes but is not necessarily limited to documentation of laboratory QC sample analysis procedures and results.

PART 2 PRODUCT

2.02 COMPOSITE BENTONITE AGGREGATE MATERIAL

- A. The basis of design shall be the AquaBlok 2080FW Composite Bentonite Aggregate (CBA) manufactured by AquaBlok, Ltd.
- B. Any substitutions or variations from the Basis of Design shall be an equivalent solution requiring express written approval from the Engineer of Record on the project.

2.03 COMPOSITE BENTONITE AGGREGATE PROPERTIES

The 20% Bentonite / 80% Aggregate blend of CBA shall have the following properties:

Tests¹	Method²	20%/80% CBA³
Visual Classification - Practice for Description and Identification of Soils	ASTM D2488	Gray poorly graded gravel with bentonite coating (GP)
Moisture Content ⁴	ASTM D2216, AASHTO T265	10-20%
Dry Bulk Density	ASTM C29	75-85 pcf
Specific Gravity ⁵	ASTM D854, AASHTO T100	2.63
Atterberg Limits - Liquid Limit	ASTM D4318, AASHTO T89	55%
Tests¹	Method²	20%/80% CBA³

Permeability - Flexible Wall Permeameter ⁶	ASTM D5084	1x10 ⁻⁷ to 5x10 ⁻⁹ cm/s
Consolidation - Incremental Loading ⁷	ASTM D2435, AASHTO T216	C _c = 0.35, e _o =0.85 Coefficient of Consolidation = 0.03-0.48 in ² /min
Consolidation - Swell Pressure ⁸	ASTM D4546, AASHTO T258	310-360 psf
Shear Strength - Direct Shear	ASTM D3080, AASHTO T236	139 psf, 31.4°
Shear Strength - Unconfined Compression ⁹	ASTM D2166, AASHTO T208	70-220 psf
Shear Strength - Triaxial Unconsolidated-Undrained (Q or UU)	ASTM D2850, AASHTO T296	520 psf, 0°
Shear Strength - Triaxial Consolidated-Undrained (R or CU) ¹⁰	ASTM D4767, AASHTO T297	180 psf, 11.7° (total) 140 psf, 25.8° (effective)
Compaction - Standard Proctor	ASTM D698, AASHTO T99	Optimum Moisture Content 16.9% Maximum Dry Density 107.5 pcf
Compaction - Modified Proctor	ASTM D1557, AASHTO T180	Optimum Moisture Content 10.1% Maximum Dry Density 123.3 pcf
Compaction - 15-Blow	US Army Corps of Engineers	Optimum Moisture Content 21.3% Maximum Dry Density 98.8 pcf
Free Swell ¹¹	ASTM D5890	25 (min.)

1. Results are based on laboratory tests for specific blends. Variability may be experienced due to manufacturing tolerances, screening, distribution of grain sizes, quality control, etc.
2. Tests were completed according to AASHTO standards when determined to be equivalent to those set by the U.S. Army Corps of Engineers.
3. Core material is typically nominal AASHTO #8 aggregate. Some variability may be expected with the use of different aggregate sizes.
4. Moisture content values are for dry material.
5. Calculated using a weighted average of the specific gravities for the material that was retained and that passed the #4 sieve. Material retained was assumed to be nominal AASHTO #8 aggregate and have a specific gravity of 2.62. Material passed was tested according to ASTM D854 to determine its specific gravity.
6. Permeability values are for freshwater scenarios. Results will vary with other permeants, and the use of other material blends may be appropriate to maintain the desired permeability.
7. Test did not strictly follow ASTM D2435, but accepted engineering applications were used to estimate settlement by analyzing the product's compression behavior under different loading conditions.
8. Swell pressure determined based on pressure required to prevent free swell during the hydration of the material prior to consolidation testing.
9. Test is commonly performed on fine-grained homogenous material, so it may not be representative of the AquaBlok product's actual strength since the product is a mixture of fine-grained material and aggregate. It is suggested that results from the UU triaxial test may provide a more reliable undrained shear strength value and is recommended for most preliminary stability analyses.
10. Triaxial unconsolidated-undrained test was performed according to ASTM D4767, saturated.
11. This test is performed only on the bentonite component and does not depend on the product composition.

2.04 AGGREGATE

- A. Aggregate used in CBA shall be nominal AASHTO #8 (1/4 – 3/8”) or custom-sized to meet project-specific needs.
- B. A limestone or non-calcareous substitute may be used if deemed project appropriate by the Owner / Engineer.

2.05 BENTONITE CLAY

- A. Bentonite Clay used in CBA shall be a natural Wyoming Sodium Bentonite (Montmorillonite) with a minimum swell index of 25 or approved equal. Properties of the Bentonite Clay may vary based on project-specific conditions.
- B. Bentonite Clay used in CBA shall be a minus 200-mesh powder (i.e., all particles passing a 200-mesh sieve) that is odorless and light gray in color. Properties of the Bentonite Clay may vary based on project-specific conditions.

2.06 BINDER

- A. Binder used in CBA shall be a cellulosic polymer as approved for use by the CBA manufacturer.

PART 3 EXECUTION

3.01 LOCATION

- A. Trench Dams shall be placed along conduits or pipes where there is potential for water to flow along the interface of the conduit and the surrounding soil.
- B. For Trench Dams used for water and sewer piping, frequency of placement shall be as directed by the Engineer and depicted on the construction drawings.
 - 1. Sanitary and storm sewers shall have, at a minimum, one (1) Trench Dam on pipe runs between manholes or structures.
 - 2. Trench Dams shall be located approximately 25 feet upstream of manholes, lift stations, or other structures.
 - 3. Water mains and force mains shall have Trench Dams spaced no greater than 400 lineal feet along the pipe run.
 - 4. Any specific conditions presented by native soils, conduit gradient, etc. may require more frequent placement of Trench Dams as specified by the Engineer.
- C. Trench Dams used in spillway pipes or other conduits through constructed embankments shall require special consideration for location with respect to theoretical zone of saturation.
 - 1. Trench Dams in embankments shall be spaced as directed by the Engineer and depicted on the construction drawings.
 - 2. Trench backfill and conduit or pipe slope shall dictate more frequent placement, if specified by the Engineer.

3.02 PREPARATION

- A. Excavate cross trench at locations designated for Trench Dam installation. A temporary or removable form may be placed to support CBA installation until trench backfill is performed All excavation and forming shall be in accordance with the project specifications.
- B. Any material or obstructions in the trench that may prevent the CBA from being placed in a uniform and consistent manner on a firm and stable substrate shall be removed.

3.03 DIMENSIONS

- A. The Trench Dam dimensions shall be directed by the Engineer and depicted on the construction drawings. Dimensions provided below are recommendations based on available industry standards and technical guidance.
 - 1. Trench Dams shall generally extend laterally to the edges of the excavated trench so that the CBA is in direct contact with undisturbed material and conduit or pipe.
 - a. If directed by the Engineer, an optional key shall be placed in the center of the Trench Dam with a thickness specified by Engineer, extending a minimum of 12 inches into undisturbed material (i.e., normal trench width) on both sides.
 - 2. Trench Dams shall extend below the conduit or pipe bottom a minimum of six (6) inches below the trench base.
 - 3. Trench Dams shall extend above the conduit or pipe top a minimum of 24 inches, but at least six (6) inches above seasonal high groundwater level.
- B. Trench Dam thickness (minimum) shall be based on outside diameter of the conduit or pipe as follows:

PIPE O.D.	TRENCH DAM THICKNESS*
0 to < 6"	0.5 FT.
6" to < 36"	1.0 FT.
36" to < 66"	1.5 FT.
> 66"	2.0 FT.

* trench depth construction constraints may necessitate greater thickness as directed by the Engineer.

- C. Soil cover above the Trench Dam shall be directed by the Engineer and depicted on the construction drawings, however;
 - 1. A minimum of two (2) feet of compacted soil and/or base shall be installed above the Trench Dam for light-duty pavement applications, and;
 - 2. A minimum of three (3) feet of compacted soil and/or base shall be installed above the Trench Dam for heavy-duty pavement applications.

3.04 PLACEMENT

- A. Placement of CBA for a Trench Dam can be accomplished via discharge from a bulk bag. Alternative placement methods include the use of concrete buckets, conveyors, chutes, etc.
- B. Ensure that the machinery (forklift, excavator, etc.) is designed to handle the weight of the bulk bag. Heed all safety messages on the bag label. Keep personnel away from suspended loads.
- C. Ensure that the material handling is performed in a clean, dry state with dry equipment. Use caution to prevent damage to the bag, straps, or spout.
- D. Mild tamping shall be performed under and at the pipe haunches as the CBA is placed to ensure that voids are minimized around the conduit or pipe.
- E. Mechanical compaction of the CBA is not typically required.
- F. After placement of CBA, a geotextile fabric is recommended for placement over the Trench Dam when residing under areas of high loading as directed by the Engineer. The fabric shall be placed so that it extends / drapes past the horizontal limits of the Trench Dam a minimum of two (2) feet on all sides.

3.05 HYDRATION

- A. In Trench Dams where thickness \geq 12 inches, CBA shall be placed in one-foot lifts with water added between lifts where possible.
- B. Once a lift is placed in the Trench Dam, intermediate hydration is recommended by uniformly spraying water over the CBA at a rate of 20 gallons per cubic yard (~0.75 gal. per cubic foot) per lift. Do not pour water into one place within the Trench Dam.
- C. Repeat the CBA lift installation, using uniformly sprayed water at the same rate until the Trench Dam is filled with CBA.

3.06 SPECIAL GUIDELINES

<Engineer to provide any additional provisions specific to the project, if desired>

*** END OF SECTION ***