



Haydite Expanded Shale
Lightweight Aggregate

Geotechnical and Electrochemical Properties of Buildex Expanded Shale Lightweight Aggregate

Buildex expanded shale lightweight aggregate has low density and a high phi angle, compared to normal weight aggregate fill materials, making it an excellent material for geotechnical fill. In addition, its electrochemical properties make it a non-aggressive fill material suitable for mechanically stabilized earth (MSE) applications.

The geotechnical and electrochemical properties of Buildex expanded shale lightweight aggregate, produced with our New Market, Missouri plant, were determined by

STS Consultants Ltd. Consulting Engineers, Vernon Hills, Illinois in their STS Project No. 30972. The project tested three different Buildex gradings, including 1/2" x No. 4, 3/8" x 1/4", and 1/4" x 0.

The results from the fifty page report are summarized here for the 1/2" x No. 4 aggregate. For a complete copy of the STS report, or for more information, please contact the Buildex office.

Grading

Sieve	% Passing	ASTM C 330 Requirement
3/4 in	100.0	100
1/2 in	94.9	90-100
3/8 in	67.2	40-80
No. 4	18.9	0-20
No. 8	5.2	0-10

Physical Properties

Property	Test Method	Test Result
Minimum density	ASTM D 4254	44 lb/ft ³
Maximum density	ASTM D 4253	49 lb/ft ³
Soundness (MgSO ₄ - 5 cycles)	AASHTO T 104	3.2% loss
φ Angle ¹	CoE EM1110-2-1906	43.5°

Note 1: Consolidated triaxial tests at 0.25, 0.5 & 1.0 kg/cm² confining stress.

Electrochemical Properties

Property	Test Method	Test Result	MSE "Non-Aggressive" Requirement
Resistivity - ssd ¹	AASHTO T 288	2.3 x 10 ⁶ ohm-cm	> 3000 ohm-cm
Resistivity - fully inundated ²		12,000 ohm-cm	
pH	AASHTO T 289	7.5	4.5 - 9.0
Chloride Content	AASHTO T 291	5 mg/kg	< 100 mg/kg
Sulfate Content	AASHTO T 290	182 mg/kg	< 200 mg/kg

Note 1: Resistivity when saturated surface dry at 22.8 percent moisture content after 48 hours immersion in water.

Note 2: Resistivity when saturated and fully inundated.

Design and Construction Considerations

Buildex 1/2" x No.4 aggregate is a free-draining coarse non-plastic aggregate¹. Buildex has an excellent long term service record of chemical and freeze -thaw durability in concrete, asphalt and geotechnical fill applications. Buildex consistently meets the requirements of ASTM C 330 *Standard Specification for Lightweight Aggregates for Structural Concrete*, including requirements that minimize organic impurities, clay lumps and friable particles, loss on ignition, and iron staining materials.

Typical Los Angeles Abrasion test results show less than 25 percent loss and Buildex has an excellent service record in highway maintenance applications for bituminous surface treatment.

The bulk (dry) specific gravity of Buildex is approximately 1.15. Water absorption at 24 hours is typically 18 percent. Buildex is normally sold by loose volume in truckload quantities. The loose density of Buildex is typically 40 - 45 lb/ft³ at the normal six percent moisture content at time of shipment.

During construction, Buildex should be compacted in place using appropriate vibratory equipment, sized to compact the aggregate adequately without causing significant particle breakage. Normal procedures will employ 12 inch lifts with a minimum 2 passes of vibratory equipment, with compaction continued until all measurable compaction has been achieved.

The in-place compacted density of Buildex 1/2" x No.4 coarse aggregate can be assumed to be 50 lb/ft³ at normal 6 percent as-received moisture content. Typical applications above the water table may be assumed to have an additional 20 percent water absorption unless the aggregate is fully protected from water intrusion. This brings the suggested in-place compacted "damp in service" density to 60 lb/ft³ for design.

Note 1: Maximum proctor density tests are not appropriate for this type of material. Determining the in-place density of any coarse clean aggregate is imprecise due to the difficulty in securing a properly compacted sample of known volume.

Guide Specification Lightweight Aggregate for Geotechnical Fill

Materials Lightweight aggregate for geotechnical fill shall be Buildex expanded shale lightweight aggregate or approved equal meeting ASTM C 330. Grading shall conform to ASTM C 330 - 1/2 inch x No. 4. The loose oven dry bulk density shall be between 35 and 50 lb/ft³ as determined by ASTM C 29. The consolidated drained triaxial test (Phi angle) shall be greater than 35 degrees as verified by test method approved by the Engineer. The Magnesium Sulfate Soundness loss shall be less than 30 percent after 4 cycles per AASHTO T 104. The LA Abrasion (Grading C) shall be less than 30 percent loss per AASHTO T 96.

For mechanically stabilized earth applications requiring non-aggressive geotechnical fill aggregate, the following Materials requirements shall also apply:

Resistivity shall be greater than 3000 ohm-cm per AASHTO T 288. pH shall be in the range 4.5 to 9.0 per AASHTO T 289. Chloride content shall be less than 100 ppm (mg/kg) per AASHTO T 291. Sulfate content shall be less than 200 ppm (mg/kg) per AASHTO 290.

Construction Lightweight aggregate shall be compacted in place during construction using appropriate vibratory equipment, sized to compact it adequately without causing significant particle breakage. Place and compact the aggregate in 12 inch lifts with a minimum 2 passes of vibratory equipment, unless otherwise directed by the Engineer. Additional passes of compaction shall be performed, if required, until all measurable compaction has been achieved.

Referenced Standards

ASTM C 330	Standard Specification for Lightweight Aggregates for Structural Concrete.
ASTM C 29	Standard Test Method for Unit Weight and Voids in Aggregate.
AASHTO T 96	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
AASHTO T 104	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
AASHTO T 260	Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials.
AASHTO T 288	Standard Method of Test for Determining Minimum Laboratory Soil Resistivity.
AASHTO T 289	Standard Method of Test for Determining pH of Soil for Use in Corrosion Testing.
AASHTO T 290	Standard Method of Test for Determining Water Soluble Sulfate Ion Content in Soil.
AASHTO T 291	Standard Method of Test for Determining Water Soluble Chloride Ion Content in Soil.

US Army Corps of Engineers EM 1110-2-1906 Appendix X - Consolidated Drained Triaxial Test.