CELLOFOAM® North America Inc.

TECHNICAL NOTE #107

CELLOFOAM® EPS ELASTIC INCLUSION TECHNICAL DATA & SPECIFICATIONS

The geosynthetic Elastic Inclusion produced by Cellofoam North America Inc. ("Cellofoam") is composed of expanded polystyrene (EPS), a rigid foamed plastic with resilient closed cells that is molded, aged, and pre-stressed for construction projects that require an energy absorbing capability to handle dynamic loads. This compressible inclusion uses a modified bead containing a fire retardant and an insecticide to provide resistance against termites and other insects. With a density of only about one percent that of traditional earth fills, Cellofoam Elastic Inclusion augments our regular Geofoam lightweight void fill product line.

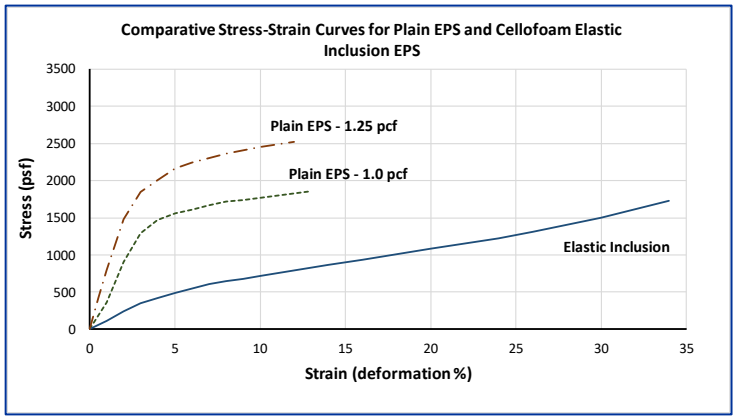

Figure 1. Typical Stress-Strain Curves for Plain and Elastic Inclusion EPS

Plain or Geofoam EPS materials exhibit a linear-elastic stress-strain relationship at relatively low deformations or strains, usually only up to approximately one percent. Elastic Inclusion EPS has been strained beyond the yield point and then unloaded to elasticize the EPS product. The subsequent material exhibits linear-elastic behavior up to approximately 10 percent strain and linear proportional stress-strain behavior up to about 30 percent strain. As a result of Cellofoam's manufacturing process, and confirmed by extensive independent and in-house laboratory physical property testing, Cellofoam Elastic Inclusion EPS has a compressive strength tolerance of 720 psf ± 60 psf at 10% strain in the prestressed direction. Figure 1 depicts typical stress-strain relationships of plain EPS versus Cellofoam Elastic Inclusion EPS. The test data was acquired via compression along the elasticized axis at a rapid loading strain rate of 10% per minute at room temperature, using conventional EPS compressive test methods.[1]

Cellofoam Elastic Inclusion material has numerous advantages over other materials that have been employed in compressible inclusion applications such as bales of straw, wood chips, or cardboard, as these materials decompose over time and consequently have changing and unpredictable mechanical properties.

Cellofoam Elastic Inclusion Advantages

- Energy absorption and load reduction
- Predictable stress-strain behavior
- Long lasting, non-decomposable
- Unaffected by freeze-thaw cycling
- Insect resistant
- Reduce construction costs
- Thermal insulator
- Vibration and noise suppression

Cellofoam Elastic Inclusion EPS provides the design engineer with consistent and predictable, anisotropic stress-strain behavior, making this product ideal for protective applications for culverts and buried pipes, tunnels, bermed structures, retaining walls, and bridge abutments. Elastic Inclusions are particularly well-suited for bridge backwalls and wingwalls where large earth pressures and excessive settlement of approach embankments from cyclical, thermal expansions of the superstructure are a concern.[2-4] Elastic Inclusions are also used to absorb dynamic surcharge loading on bridges or other building structures such as to reduce pressure from construction, flooded earth fill, or to absorb traffic or earthquake loads.[5] In many cases, Elastic Inclusions have served to lower net construction costs by reducing the amount of more expensive materials used, such as concrete and steel.

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While Cellofoam Elastic Inclusion EPS is usually used in new construction, it may also be employed to cost effectively rehabilitate or retrofit existing structures to increase design safety factor for geotechnical or structural loads from seismic activity, expansive soils and rock, or nearby traffic loads from roadways, trains, or airports.[6]

Specifications of Cellofoam Elastic Inclusion EPS

Characteristic	Specification
Stress-Strain Behavior	The EPS is elasticized, with linear-elastic stress strain behavior up to 10% strain and linear proportional stress-strain behavior up to 30% strain.
Compressive Strength	720 psf (5.0 psi) ± 60 psf (0.42 psi) at 10% strain, as prescribed in Test Method ASTM D1621.
Chemical Constituents & Compatibility	The EPS contains no chlorofluorocarbons (CFCs), hydro chlorofluorocarbons (HCFCs), hydro fluorocarbons (HFCs) or formaldehyde. It is chemically and biologically inert when in contact with acidic and alkaline soils. The material will not deteriorate because of contact with sodium chloride, calcium chloride, mild alkalis and acids, or other ice control materials.
Fire Resistance	The EPS contains a flame retardant additive.
Insect Resistance	The EPS is treated with an insecticide to provide resistance to insect attack.
Water Absorption	≤ 3% by volume, as prescribed in Test Method ASTM C272, Procedure A, or its equivalent, Test Method ASTM C1763, Procedure C.
Working Temperature	The EPS will withstand temperature variations from -68 ^{o}F to 140 ^{o}F without deforming and will maintain its original dimensions and placement without chipping, spalling, or cracking.

Quality assurance of all Cellofoam Elastic Inclusion EPS is confirmed by extensive independent and in-house laboratory physical property testing. In addition to Elastic Inclusion EPS, Cellofoam produces UL Listed EPS insulation and geofoam to ASTM C578 and D6817 specifications, respectively, and numerous other EPS products.

References

1 ASTM D1621-16, *Standard Test Method for Compressive Properties of Rigid Cellular Plastics*.

2 Horvath, John S., "*Using Geosynthetics To Reduce Surcharge-Induced Stresses on Rigid Earth-Retaining Structures*, p. 47-53, Transportation Research Record 1330, National Academy of Science, 1991.

3 Hoppe, Edward J., Final Report, *Field Study of Integral Backwall with Elastic Inclusion*, Senior Research Scientist, Virginia Transportation Research Council, VTRC 05-R28, Apr. 2005.

4 Horvath, John S., "*The Compressible Inclusion Function of EPS Geofoam: An Overview*," Proceedings of International Symposium on EPS Construction Method, p. 72-81, EPS TOKYO '96, Japan, 29-30 Oct. 1996.

5 Dave, T.N. et al., "*Evaluation of Seismic Earth Pressure Reduction using EPS Geofoam*," Proceedings of the 18th International Conference on Soil Mechanics and Geotechnical Engineering, Paris 2013.

6 Stark, Timothy D., et al., "*Expanded Polystyrene (EPS) Geofoam Applications & Technical Data,*" p. 2-15, EPS Industry Alliance, Dec. 2011.

Warning: This product is combustible and if exposed to a fire of sufficient heat and intensity may burn rapidly. It should not be left exposed or inadequately protected. Long-term (several months or more) exposure to ultraviolet radiation will cause discoloration. Protect Cellofoam Elastic Inclusion from exposure to hydrocarbons, coal tar pitch, solvents, and solvent fumes. Consult specific instructions and applicable building codes for use of this product.

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EPS Industry Alliance Member