



Cellular Concrete LLC's patent-pending **GEOFOAM SP™** is a synthetic foaming agent which, when added to engineered cement slurry, enables the production of pervious cellular lightweight concrete. With a drain rate tested at 230 feet per hour, this permeable, open-celled, low-density concrete is able to stabilize soil without disturbing or redirecting natural water flow. Pervious cellular lightweight concrete is a proven solution for many challenging geotechnical applications, including sports fields, golf courses, backfilling, parking lots, void filling, pavement subbase, and landscaping. In underground pipeline fill applications, should the pipeline leak, the permeable nature of Geofoam SP™ pervious cellular lightweight concrete allows for quick locating of the source.

Frequently asked questions (FAQs) about **GEOFOAM SP™** follow.

### **Where has Geofoam SP™ pervious cellular lightweight concrete been used?**

The highest profile project we are aware of is the future home of the New York Mets, where 17,500 cubic yards of Geofoam SP™ pervious cellular lightweight concrete was installed in 2006.

The new baseball venue, which will be called Citi Field, is being built in the parking lot beyond Shea Stadium's left field wall. Design calls for the playing surface of the new field to be elevated five-to-six feet above the grade of the old parking lot. Traditional fill to accommodate this design would add an estimated 700 pounds per square foot to the area, which would cause substantial settlement to the area's weak native soils and require lengthy and expensive soil surcharging until the settlement subsided and construction could continue.

Many options for reducing the load on the underlying soils were explored, including using lightweight aggregate as fill, which would have yielded a density of about 55 pounds per cubic foot after compaction. But Geofoam SP™ pervious cellular lightweight concrete, designed to achieve an average density of 29 pounds per cubic foot and average strength of 80 psi, proved to provide the best solution for the design, resulting in direct savings of more than \$500,000 and considerable contraction of the project's construction schedule.

Non-pervious fill solutions would have required the design, construction, and installation of an extensive (and expensive) field drainage system. As of this writing, construction continues on track at Citi Field. The Mets expect to occupy their new stadium on Opening Day, 2009.

## **Can Geofam SP™ pervious cellular lightweight concrete be used in cold weather climates?**

Due to the 60% percent void structure of Geofam SP™ pervious cellular lightweight concretes, natural water flow passes through the material and into the subgrade below.

Though the material does retain water, it is seldom fully saturated. When moisture is present at freezing temperatures, the void structure of pervious lightweight concrete provides ample room for expansion.

## **Won't the void structure in Geofam SP™ pervious cellular lightweight concrete clog over time?**

Geofam SP™ pervious cellular lightweight concrete performs much like the drainage and erosion mats used in geotechnical construction, which have a long history of durable performance.

If you were to place soil directly on top of a sample of Geofam SP™ pervious lightweight concrete and pour water on it for an extended period, the soil would not enter the entire sample and the permeability of the Geofam SP™ pervious lightweight concrete would remain excellent, despite some soil infiltration.

But in real-world, load-reduction geotechnical applications, Geofam SP™ pervious lightweight concrete is not called upon to directly handle stormwater or irrigation contaminated with soil, sand, dirt, leave fragments or other permeability-inhibiting debris. Instead, Geofam SP™ pervious lightweight concrete provides increased compressive and shear strength and a permeable separation between topsoil or pavement and native soils, allowing natural moisture to pass through the material and enter the subsoil below.

When used as an underlayment for permeable pavements (pervious concrete or porous asphalt) Geofam SP™ pervious lightweight concrete provides a uniformly compacted, permeable subbase and can be designed to provide storage capacity for the permeable pavement system, replacing compacted clean stone or other aggregate recharge fields.

In active stormwater mitigation systems, Geofam SP™ pervious lightweight concrete not only drains, but also retains. Because of a higher void area, compared to aggregate fill materials, Geofam SP™ pervious cellular lightweight concrete can retain as much as 50% more water. Thus, Geofam SP™ pervious cellular lightweight concrete enhances the performance of permeable pavement applications, especially on project sites where native soils provide slow drainage characteristics.

## **How do you place Geofam SP™ pervious cellular lightweight concrete?**

Most often, Geofam SP™ pervious cellular lightweight concrete is placed by pumping and will move through the pump lines using less pressure than for typical grout mixes. The synthetic foaming agents produced by Cellular Concrete LLC concrete are celebrated in the field for

enhancing longevity and durability in cellular lightweight concrete applications. The durable cell structure of Geofoam SP-produced pervious cellular lightweight concretes is not affected by long pump runs, extended mixing, or most fly ashes and have been successfully pumped up beyond 500 feet vertically and 5,000 feet horizontally. Installation rates of more than 100 cubic yards per hour are common.

### **Are there lift requirements when placing Geofoam SP™ pervious cellular lightweight concrete?**

In general, cellular lightweight concretes are placed in 2' to 4' lifts, depending on cell size, with nothing is done between lifts (although in rare cases, a project specification will require scarification between lifts). Cellular lightweight concretes produced from synthetic foaming agents (like Geofoam SP™) can handle higher depths than protein-based foaming agents and have successfully been placed in lifts as tall as ten feet.

### **What is a typical mix design for Geofoam SP™ pervious cellular lightweight concrete?**

As the world leader in the manufacture and supply of engineered foam liquid concentrates, Cellular Concrete LLC excels at working with geotechnical specifiers and contractors to ensure the mix design for Geofoam SP™ pervious cellular lightweight concrete provides a site-specific solution for project geotechnical challenges.

A .5 water to cement ratio slurry consisting of two parts cement to one part water is often used as a base mixture for cellular concrete applications. The water cement ratio for Geofoam SP™ pervious cellular lightweight concretes will vary, based on specific project requirements. Cellular lightweight concretes obtain natural fluidity from their foaming agent air bubble structure, not from excess water content. Sand or other aggregate can be used in Geofoam SP™ pervious cellular lightweight concrete mixes; however lab mixes should be run to determine acceptable flowability.

### **Can fly ash be incorporated into Geofoam SP™ pervious cellular lightweight concrete mix design?**

Infusing and supporting cellular concrete with an air-cell system is a mechanical action and is not problematic with fly ash or concrete foaming agent chemistry. The durable cell structure of Geofoam SP™ is not affected by most fly ashes and results have been favorable with high-carbon fly ashes.

### **How fast does Geofoam SP™ pervious cellular lightweight concrete set up?**

Set time depends on many factors, including mix design, air temperature, and humidity. In general, Geofoam SP™ pervious cellular lightweight concrete sets in the same time as normal concrete ... can hold its weight after six hours ... and be walked on within 24 hours.

When conditions or project schedules require faster set times, set-accelerating admixtures – if approved by Cellular Concrete LLC – can be incorporated into the mix.

## **Does shrinkage affect Geofam SP™ pervious cellular lightweight concrete?**

Shrinkage is minimal, less than 0.6%. Any cracking of the material does not affect its designed load bearing capacity, which is similar to soils.

## **What geotechnical construction challenges are appropriate to meet with Geofam SP™ pervious cellular lightweight concrete?**

Geofam SP™ pervious cellular lightweight concrete is the appropriate solution wherever low-density, free draining material is needed. Typical applications include:

- Self-leveling fill
- Drainage structures
- Scour protection
- Sport fields/golf courses
- Tunnel backfill
- Underground tanks
- Bridge approaches
- Soil stabilization
- Permeable road base
- Foundation drains
- Gabion retaining systems
- Annular fill
- Underground pipelines
- Load-reducing fill over underground structures.
- Water retention
- Pipeline beds
- Greenhouse floors
- Fill for abandoned mines
- Impact absorption
- Landslip repair fill

## **What densities and strengths are available with Geofam SP™ pervious cellular lightweight concrete?**

Mix design determines the strength and density of Geofam SP™ pervious cellular lightweight concrete. Engineered cement slurry mixes can range from 50 psi to 200 psi, with wet-cast densities from 20 to 30 pounds per cubic foot. When replacing soils, cellular concrete can be designed to provide whatever strengths and drainage characteristics are needed for the project.

## **What are the advantages of using Geofam SP™ pervious cellular lightweight concrete instead of lightweight aggregate?**

There are appropriate roles for lightweight aggregate to play in geotechnical construction. In general, Geofam SP™ pervious cellular lightweight concrete advantages include:

- Geofam SP™ pervious cellular lightweight concrete weighs considerably less than lightweight aggregate.
- Geofam SP™ pervious cellular lightweight concrete solutions are less expensive than lightweight aggregate solutions.
- Geofam SP™ pervious cellular lightweight concrete is self-leveling and can be pumped into areas that are hard to access.
- Geofam SP™ pervious cellular lightweight concrete requires no compaction.

## **What testing is used to verify Geofam SP™ pervious cellular lightweight concrete is performing to specification?**

Properties tested include strength, density, air stability, flow rate, and heat-of-hydration.

## **Does Geofoam SP™ pervious cellular lightweight concrete replace traditional pervious concrete in permeable pavement applications?**

No. But when used as an permeable pavement underlayment and recharge bed – replacing crushed stone – Geofoam SP™ pervious cellular lightweight concrete enhances the performance of permeable pavement applications, especially on project sites where native soils provide slow drainage characteristics.

Crushed rock has a void area of approximately 30% to 40%. Geofoam SP™ pervious cellular lightweight concretes have void areas in the range of 50% to 60%.

Thus, Geofoam SP™ pervious cellular lightweight concrete can retain as much as 50% more water than crushed rock. In situations where crushed rock is specified as the recharge bed over poorly draining soil, you can reduce excavation depth by as much as 50%, or retain 50% more water, by replacing the crushed stone with Geofoam SP™ pervious cellular lightweight concrete.

Other advantages of using Geofoam SP™ pervious cellular lightweight concrete in permeable pavement applications include:

- Geofoam SP™ pervious cellular lightweight concrete is a solid consistent subbase that will not shift over time and will not deteriorate or settle into the soil.
- Geofoam SP™ pervious cellular lightweight concrete can reduce the amount of excavation by as much as 50%. This saves time and money and reduces the project's carbon footprint.
- Geofoam SP™ pervious cellular lightweight concrete has an enhanced filtering capability, which will keep the ground water cleaner.
- Geofoam SP™ pervious cellular lightweight concrete can be produced with fly ash, which may support LEED Credits.
- Geofoam SP™ pervious cellular lightweight concrete reduces the mining of aggregate, which reduces the project's carbon footprint and extends the useful life of existing local aggregate operations, delaying or helping to eliminate the need to permit and open additional aggregate operations.

## **Are there environmental performance advantages to Geofoam SP™ pervious cellular lightweight concrete?**

Testing by Middle Tennessee State University documents the ability of Geofoam SP™ pervious cellular lightweight concrete to enhance the environment by filtering contaminants that can adversely affect soil and water.

Various solids and chemicals were placed on Geofoam SP™ pervious cellular lightweight concrete samples and rinsed with increasing amounts of water over a given surface. Test results showed Geofoam SP™ pervious cellular lightweight concrete filtered 78% of the hydrocarbons and heavy metals; oil retention testing showed 97% of the oil remained on the Geofoam SP™ pervious cellular lightweight concrete test specimen.

## **Does Geofoam SP™ pervious cellular lightweight concrete support LEED objectives?**

LEED incorporates a holistic approach to sustainable development, making it difficult to define the independent role the thousands of materials and products bring to supporting project-specific sustainable objectives.

But using Geofoam SP™ pervious cellular lightweight concrete may help increase the number of points awarded to a project in the LEED system.

When used to support permeable pavements, Geofoam SP™ pervious cellular lightweight concrete helps reduce site stormwater flow and site pollutant loads, which may contribute to LEED Credit SS 6. By helping to integrate drainage and paving, less site area may need to be used to manage stormwater, allowing for more compact site footprint development, which may contribute to LEED Credit SS 5. When incorporating fly ash into the mix design, Geofoam SP™ pervious cellular lightweight concrete substitutes partially for cement, which may contribute to LEED Credit M 4.