W H I T E P A P E R

Pumice *and* LEED Certification

EXECUTIVE SUMMARY

The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) certification program has been embraced worldwide and is the predominant green building certification system in the US. Success with the goals of the LEED certification process—environmental performance, improvement of occupant well- being, and economic return—are well documented, and the program continues to evolve with the addition of new ratings systems.

As the program evolves and grows, so too does the need to understand the fit—both in cost and performance—of a wide range of effective materials and processes to meet the requirements.

As product use alone does not provide LEED points, the information in this white paper focuses on identifying the LEED categories and options where pumice and pumice-enhanced products can be valuable contributors to the goal of LEED certification.

Not all pumice is created equal, nor are the refining processes, product blends, and the company behind those products. Hence, the information that follows is attuned specifically to the pumice products produced by Hess Pumice of Malad City, Idaho.

Hess PUMICE IDAHO USA

Detailed information on the LEED program and project certification process is available on the USGBC website, www.usgbc.org.

CONSULTATION on the LEED-specific information in this white paper was provided by **Sarah Andrews** CSI, CDT; LEED AP BD+C; a member of the USGBC Faculty and an AGC Approved Instructor

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Possible LEED Points Available Using Pumice Products

BROWNFIELD REDEVELOPMENT AND REMEDIATION: *Rehabilitate damaged sites, reducing pressure on undeveloped lands.*

■ US Grout Microfine and Ultrafine pozzolanic cementitious grouts can be used to solidify and stabilize contaminated soils and reduce leachate concentrations to below regulatory levels. The grouts fully permeate soils, effectively eliminating or substantially mitigating water infiltration and exfiltration of contaminants in polluted soils. Cementitious grouts are economical, effective, enduring, and non-hazardous.

The original formulation for the US Grout product was developed by the U.S. Department of Energy's Sandia National Laboratory to seal microfractures in the salt rock

Pozzolanic cementitious grouts economically stabilize soils and mitigate leachate around the underground isolation chambers at the DOE's Waste Isolation Pilot Plant (WIPP). The grout successfully penetrated and sealed microfractures as small as 6 microns against water infiltration from without and the migration of radionuclides and other contaminants from within.

While US Grout products continue to effectively seal fractures in the rock of tunnels, mines and storage caverns throughout the world, the original cementitious grout formulation has been adapted to effectively and efficiently penetrate soils. Once injected into the soil, the grout stabilizes, imparts load-bearing compressive strength, and seals against leachate within almost any soil type—even the fine-grains soils that defeat effective penetration by other grouts.
SEE ALSO: www.usgrout.com

VARIOUS CATEGORIES: *Sustainability and Environmental Considerations addressed by utilizing permeation grouting, perlite, and pumice.*

- If a potential site meets the LEED Site Selection criteria and/or is located in a developed area with existing infrastructure, but is found to have existing soil conditions that do not support the project in terms of soil stability, load-bearing capacity, compaction requirements, or any other concerns brought on by poor native soil or underlying structure, it need not be rejected outright. A soil-permeating cementitious grout can provide the needed soil stability and/or compressive strength for a building, thus reducing the environmental impact in undeveloped areas or greenfields. The flexible mix design of the US Grout VX product in particular makes it viable in many soil types. Sites that were built up using indiscriminate infill methods, soil types, and junk fills can often be stabilized and made usable with permeation grouting.

- If, following the performance of a site assessment study to assess pre-design conditions, the soils of a potential site are not up to engineer-specified requirements for supporting a larger structure (or if the soil anatomy contributed to the demise of the existing structure), permeation grouting with a cementitious grout can provide the proper conditions necessary to provide load-bearing capacity, control ground water infiltration below grade, or meet other code requirements, such as the strict code requirements in high rainfall and/or earthquake-prone regions concerning building on soil types susceptible to liquefaction.

- For project sites with identified poor native soil, improving the in-place soil within the designated vegetated areas is paramount to long-term success. Although good topsoil can be trucked in to replace the deficient soil, a more cost-effective alternative to soil removal and replacement (especially on a large scale) may be to amend and improve the native soil. Blending pumice (one-eighth minus) into the soil as a non-organic, foundational soil conditioner, then adding organic material to kick start the soil's health profile will provide the necessary soil structure to support long-term healthy plant life in project open spaces.

- When re-establishing native plant species to disturbed grounds around the building site (greenfield site) or working to re-introduce appropriate native or adapted plants (previously developed areas/graded sites), pumice is an excellent large-scale soil conditioner that works to improve the performance of poor native soils as well as repair construction-damaged soils. The LEED requirement calls for these restored "natural states" to require minimal or no irrigation, need no active maintenance such as mowing or fertilizing, and provide habitat value and biodiversity. Pumice is an economical and permanent choice for conditioning the site soils to perform to the stated standard. Exterior open spaces that encourage interaction with the environment, social interaction, passive recreation, and physical activities also contribute toward the health, well-being, and productivity of building occupants.

LEED Category and credits possible using pumice products:

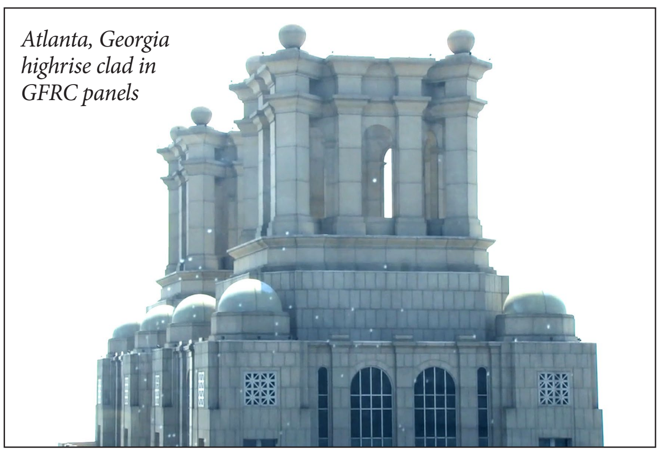
1) Location and Transportation – Sensitive Land Protection, Surrounding Density and Diverse Uses

2) Sustainable Sites – Site Selection, Site Assessment, Site Development – Protect or Restore Habitat, Open Space

VARIOUS CATEGORIES: *Sustainability and Environmental Considerations addressed by utilizing precast Glass Fiber Reinforced Concrete products.*

- Glass Fiber Reinforced Concrete (GFRC) panels are often used to contribute LEED points towards certification, as they have many characteristics that enhance green credibility. Typically used as exterior cladding for buildings (though they are used internally, as well), cement-based GFRC panels are strong, design-flexible, long-lasting, and amazingly lightweight. Being a lightweight pre-cast product, they also limit project site congestion and waste and they ship efficiently.

GFRC products are mentioned here because the latest panel formulations further enhance the green cred of GFRC products by utilizing an ultrafine pumice pozzolan (Hess Ultrapozz) to both enhance the strength and durability of the cement-based composite and to replace a percentage of the Portland cement needed. The added capability of providing new exterior cladding to allow the reuse of an existing structure supports numerous green strategies, including building life cycle impact reduction and taking advantage of the built environment to reduce pressure on undeveloped sites.



Atlanta, Georgia highrise clad in GFRC panels

LEED Category and credits possible using GFRC products on the exterior:

1) **Location and Transportation** – Surrounding Density and Diverse Uses

2) **Energy and Atmosphere** – Optimize Energy Performance

3) **Materials and Resources** – Building Life Cycle Impact Reduction; Construction Waste Management; Building Product Disclosure and Optimization – Environmental Product Declarations, Sourcing of Raw Materials, Materials Ingredients; Regional Materials

4) **Indoor Environmental Quality** – Construction Indoor Air Quality Management Plan

Additional LEED Category and credits possible using GFRC products on the interior:

1) **Indoor Environmental Quality** – Low-Emitting Materials; Interior Lighting; Daylight

RAINWATER MANAGEMENT AND STORM WATER DESIGN: QUALITY AND QUANTITY CONTROL: *The intent of these credits is to replicate and limit disruption of natural water hydrology and water balance of the site by reducing impervious cover, increasing on-site infiltration, eliminating contaminants, and to limit disruption and pollution of natural water flows by managing storm water runoff and reducing pollutant loadings. Increased infiltration also reduces the size and cost of Best Management Practices (BMPs) used to treat runoff.*

- Pumice works as an aggressive storm water filtering agent within engineered soils and soil constructs such as roadside, walkway and parking lot runoff filtration strips, ecology embankments, and engineered wetlands for better on-site filtration. The microscopic vesicles that are inherent in pumice (one-eighth minus) work to grab and hold chemical contaminants lifted from impervious surfaces and carried away in storm water runoff. Pumice soil will also improve the health and viability of erosion-fighting vegetation used to stabilize and beautify filtration constructs.

- Pumice is an inorganic soil amendment that endures and performs indefinitely within the soil. When liberally mixed with dense, heavy native soils with poor water-handling properties, pumice-enhanced soils will facilitate drainage, absorption and water retention, thus reducing water-related problems while supporting soil stabilizing vegetative cover plantings.

HEAT ISLAND REDUCTION: *This credit's intent is to reduce heat islands to minimize impacts on microclimates and human and wildlife habitats. The credit requires the use of vegetative shade (within 10 years of occupancy) and shading devices, and/or the use of highly reflective materials which maintain their reflectance properties over time. The non-roof requirement can be met by using concrete, light colored pavers, or open-grid pavers rather than asphalt for pervious or impervious surfaces. Generally, light-colored surfaces have a high SRI, but this is not always the case. Surfaces with lower SRIs absorb more solar radiation. The absorbed radiation is converted into heat and the surface gets hotter. The Solar Reflectance Index (SRI) is a measure of the* *constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100.*

- Using the whitest commercial pumice pozzolan available as the pozzolanic performance ingredient in a concrete mix design will help boost the reflectance numbers of concrete surfaces, especially as it ages. Using white pumice pozz not only helps attain the Heat Island credit, but pumice pozzolan works as a cement replacement product—replacing up to 40% of the Portland cement may earn additional points.
- Vegetated roofs for parking and shading structures need lightweight soil mixtures that could include Hess Perlite or Hess Pumice to increase the horticultural performance of the soil at a reduced weight contribution to the final load of the soil blend on the roof system. Hess products not only serve as lightweight soil components, but are excellent and proven performers as soil conditioners. They work within the soil to retain nutrients and water and keep the soil friable. Being non-organic, perlite and pumice will last (and function) indefinitely within the soil.
- Light colored pavements also contribute to achievement of LEED credits by reducing the amount of exterior lighting needed in paved areas to meet safety and security needs which in turn improves energy efficiency.
- White pumice stone mulch can also be used to both help retain water, mitigate wind erosion of soil, and reduce solar gain on the roof.

SEE ALSO: www.hesspumice.com/pumice-pages/pumice-uses/horticultural-pumice.html

OUTSIDE WATER USE REDUCTION AND WATER EFFICIENT LANDSCAPING: *Limiting or eliminating the use of potable water resources available on or near the project site for landscape irrigation. Options include reduction of potable water use or no potable water use.*

- Pumice is an economical large-area landscaping choice for conditioning soil in two major areas. One, it structurally improves the friability of the soil, resisting compaction and preventing excess runoff in poor clay soils by promoting absorption. Improving the structural friability of a heavy, sticky soil assures available water reaches plant roots and that the soil in the root zone allows the respiration plant roots require. Two, pumice greatly aids a soil's ability to retain moisture, especially light, sandy soils, as the tiny pumice stones (a fine-crushed 1/8 minus grade is best for blending with soil) are laced with microscopic pores that hold onto water and vital nutrients, extending the time between watering and fertilizing applications. Pumice will not compact or decompose over time and so functions continuously. Pumice is also pH neutral.

Rooftop Gardens grace this view in Vancouver, BC Canada

- Even the performance of acceptable-to-good soils can be greatly improved by the water-retention qualities of pumice in sandy soils or the compaction resistance qualities pumice lends to soils with moderate clay content. In arid-climate regions, pumice will help the soil retain moisture and reduce turf and landscape watering requirements. In wet climates, pumice in heavy soil helps facilitate drainage and mitigate runoff damage.

SEE ALSO: www.hesspumice.com/pumice-pages/pumice-uses/horticultural-pumice.html

MINIMUM ENERGY PERFORMANCE AND OPTIMIZE ENERGY PERFORMANCE: *Components constructed of concrete generally are considered "mass." This means they have enough heat-storage capacity to moderate daily temperature swings. In many climates, these buildings have lower energy consumption than non-massive buildings with walls of similar thermal resistance. When buildings are properly designed and optimized, incorporating thermal mass can lead to a reduction in heating, cooling, ventilating, and air-conditioning equipment capacity. Reduced equipment capacity can represent energy and construction cost savings. Points are awarded under the credit based upon energy cost savings compared to a baseline building that meets the requirements of ASHRAE/IESNA 90.1-2007 or 90.1-2010. When concrete is considered, it is important to determine energy savings using a whole building energy simulation program that calculates yearly energy use on an hourly basis. Such programs are needed to capture the beneficial thermal mass effects of concrete. Insulated concrete systems, used in conjunction* *with other energy-saving measures, will be eligible for points. The number of points awarded will depend on the building, climate, fuel costs, and minimum requirements of the standard. Studies show using concrete walls insulated to exceed minimum code requirements by a modest amount (about the same as minimum requirements for frame walls) can contribute to earning points, depending on the building type, orientation, and climate.*

- Pumice concrete has several advantages that can be calculated into the energy performance of a building to meet both the prerequisite and earn credit points.

Natural pumice pozzolan can replace up to 50% of the portland cement in the mix design

- R-value for the same width of standard-aggregate concrete wall is increased 4 times, and the thermal mass benefits still remain. With the increased R-value inherent in the pumice concrete walls themselves, additional insulation needs go down.
- Weight of the pumice concrete is less (up to 1/3 less than conventional sand-and-gravel concrete) meaning less deadweight on supports and framework, less structural steel is needed, less concrete use overall with smaller possible footings.
- The light color of concrete containing pumice also contributes to energy efficiency performance by decreasing the need for electrical lighting and supporting the effectiveness of daylighting approaches which have been shown to increase occupant comfort and productivity.
- Pumice products also offer additional points in the Materials and Resources credit category through the Building Product Disclosure and Optimization paths by encouraging corporate sustainability, responsible sourcing, and environmental transparency policies. Hess pumice is chemically inert, and contains no crystalline silica, lead, mercury, arsenic, or carbon.

SEE ALSO: www.hesspumice.com/pumice-pages/pumice-uses/pumice-concrete.html

REGIONAL MATERIALS: *This credit supports the use of local materials and reduced transportation distances. The requirements mandate the use of building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site. Concrete will usually qualify since ready-mix and precast plants are generally within 50 miles of a job site.*

- Mine-grade pumice aggregates used for pumice concrete—including pumice sand—are most economical when shipping to ready-mix and precast concrete plants within the specified 500-mile radius, which fits nicely within the project site radius specified in the Regional Materials requirement.
- The same shipping efficiencies apply to the one-eighth minus mine-grade pumice used for soil conditioning applications as well.

REDUCE CEMENT CONTENT: *An Innovation in Design credit may be available if the cement in concrete is replaced with slag cement, fly ash, or a combination. Slag cement is commonly used at replacement levels up to 60%. However, using fly ash replacement levels for Portland cement greater than 25% is not routine.*

NOTE: When using a natural pumice pozzolan, a replacement level of 40% is routine.

- Not only can pumice pozzolan effectively replace Portland cement, in so doing the pumice pozzolan ignites an extremely beneficial secondary reaction within the curing concrete that consumes deleterious byproducts from the Portland cement-meets-water hydration reaction. This “molecular reclamation” reaction both mitigates the problems caused by the deleterious compounds (sulfate attacks, chloride attacks, effloresce, freeze-thaw damage, alkali silica reaction, reduced compressive strength and abrasion resistance) and transforms them into beneficial compounds, effectively densifying and strengthening the concrete.

SEE ALSO: www.hesspozz.com; www.hesspumice.com/pumice-pages/pumice-uses/pumice-pozzolan.html

Please consult a LEED accredited professional for the latest details of meeting LEED requirements for certification.

—by **Brian Jeppsen**, VP-R&D, Hess Pumice Products of Malad City, Idaho.

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