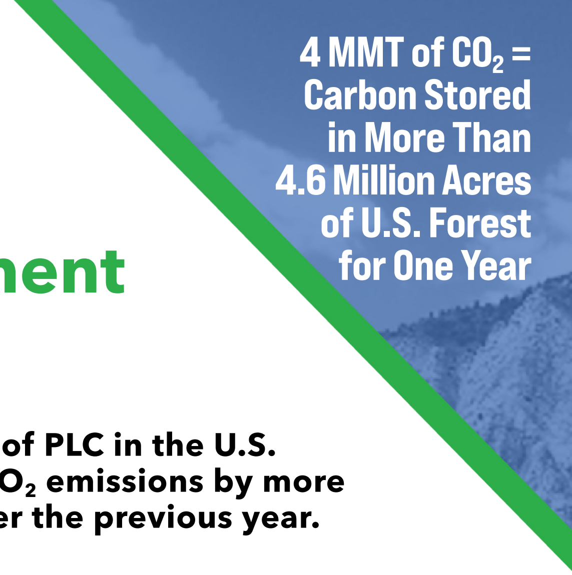
portland-limestone cement

2024 Portland-Limestone Cement U.S. Fact Sheet



Lower-carbon cements make a difference. Last year, the use of PLC in the U.S. surpassed that of portland cement, a change that reduced CO_2 emissions by more than 4 million metric tons, more than 2x the CO_2 savings over the previous year. And that's just the beginning.

Portland-limestone cement (PLC), or Type IL, is engineered with a higher limestone content than portland cement to reduce the carbon footprint of concrete by up to 10%. It performs similar to the cement you're used to using, resulting in concrete with a better carbon profile.

The cement and concrete industry are committed to carbon neutrality by 2050 (**cementprogress.com**). Because society places so much concrete each year, small changes to its formulation can have dramatic effects on the construction industry's annual carbon footprint. Modifying a concrete mixture to replace higher carbon materials with lower carbon ingredients is an effective strategy. Portland-limestone cement offers a solution for concrete producers to accomplish this, much like fly ash and slag cement have done for decades. Concrete mixtures designed with PLCs are also compatible with all supplementary cementing materials (SCMs); PLCs can be used in ternary blended cements or in ternary concrete mixtures for an even greater reduction in carbon footprint.

Though these are innovative, PLCs are not new products. Cement standards in the U.S. (ASTM C595, AASHTO M 240) and Canada (CSA A3001) have recognized portland-limestone cements for over a decade. And even before that, some manufacturers were producing PLCs under the performance specification for cement (ASTM C1157).

Adoption in U.S. Building Codes… And More

The cement industry has made great strides toward the acceptance of PLC, allowing the U.S. to transition to environmentally friendlier concrete. Both the availability and acceptance of PLCs have increased over the past decade in the U.S. As of Febrary 2024, U.S. State Departments of Transportation have accepted the use of portland-limestone cements in all 50 states. ACI 318, Building Code Requirements for Concrete Construction, includes PLCs and other blended cements. Along with code recognition, PLCs are similarly included in ACI 301, Specification for Structural Concrete and ASTM C94, Specification for Ready Mixed Concrete. In addition, PLCs are in recognized by the International Code Council, the Federal Aviation Administration, and the American Institute of Architects Master Specification.

Applications

Portland-limestone cement and concrete mixtures containing PLC have been used around the world for decades. In the U.S., PLCs have an established track record for transportation infrastructure. Many states have been placing PLC concrete pavements for more than a decade—with positive results. For buildings, pavements, bridges, and other applications, PLC concrete is a natural fit forstructural members of any type or size, and it's also great for exterior finishes and hardscaping. Architects and other designers who are tasked with meeting goals put forth by green rating systems or codes will find PLC an especially useful material to help them achieve a lower carbon footprint for any project.

Proportioning Concrete Mixtures with PLC

Start with the same amount of PLC to replace portland cement, and then test the mixture to confirm fresh and hardened properties. PLC is generally designed to replace portland cement at the same cement content to result in comparable concrete performance. The production of PLC includes controlling cement fineness, particle size distribution, and sulfate content to provide similar performance when compared to portland cement made from the same clinker.

Research studies and real-world concrete placements have demonstrated that by following well-documented mixture design and quality control practices, concretes made using PLC can perform similarly to concretes made with portland cement. Maintaining concrete behavior requires additional trial batching as when changing from one source of cement to another.

Research and Testing

PLC has been subjected to extensive research and testing by industry, both in the U.S. and elsewhere. Researchers have studied fresh properties related to placing and finishing, as well as hardened properties that relate to durability (**PCA R&D SN3148**).

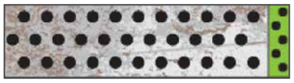
Areas studied include resistance to scaling and freeze-thaw, chlorides, sulfates, and alkali-silica reaction. Each type of exposure has been thoroughly investigated to confirm that PLC produces strong, durable concrete.

Just like concrete made with portland cements, concrete mixtures made with PLC should be tested to confirm fresh and hardened properties such as air void content, strength, freeze-thaw durability, and sulfate resistance, as needed for the project.

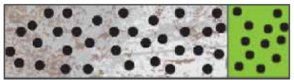
Manufactured with Lower CO_2

Cement is made by grinding clinker—the main energy intensive ingredient—to a fine powder. The same clinker is used to make both portland cement and portland-limestone cement. Whereas the U.S. standard for portland cement allows for up to 5% of clinker to be replaced by limestone, the standard for blended cement allows for 5% to 15% limestone replacement in PLC.

Portland cement can contain up to 5% limestone along with the clinker.



Portland-limestone cement can contain from 5% to 15% limestone along with the clinker.



To assure similar performance in concrete, manufacturers optimize portland-limestone cements. Limestone characteristics, limestone content, properties of other cement ingredients, and various options in manufacturing processes are considered. Finely ground limestone can contribute to development of microstructure, particularly when fineness and chemistry of the finished cement are carefully controlled by the manufacturer. Limestone is easier to grind than clinker, and the fineness of a PLC is generally higher than that of portland cement from the same source. The limestone particles can pack closer together to tighten the concrete matrix and their finer grind makes them slightly more reactive. And with the particles distributed throughout the mixture, they can provide additional "nucleation" sites for chemical reactions to take place. All of this helps control strength development, and ultimate strength, and reduce concrete permeability.

Doing More to Reduce Carbon Emissions (or GHG)

By specifying PLC, you can typically achieve a reduction of up to 10% of the CO_2 footprint for concrete. For the best understanding of your CO_2 savings with PLC, ask your cement provider.

Since the 1970s, improvements to U.S. cement manufacturing have resulted in a more than 40% decrease in production energy while also reducing CO_2. The innovation of PLC can be viewed as yet another improvement in a long line of developments introduced by the cement industry to lower its energy and carbon footprints: converting wet kilns to dry kilns to reduce the energy for combustion, adding preheaters and precalciners to cement kilns to improve energy efficiency, and using waste for energy to reduce the burden on landfills.

As society looks to the future, cement manufacturers can offer a major contribution on the part of the construction industry to help address global climate change. PLC offers specifiers, architects, engineers, and designers a more sustainable concrete while still offering the resilience and durability they've come to expect from it.