

TERMINOLOGY

Slag cement (Ground granulated blast-furnace slag): A hydraulic cement formed when granulated blast-furnace slag is ground to a suitable fineness.

Granulated blast-furnace slag: The glassy, granular material formed when molten blast-furnace slag is rapidly chilled as by immersion in water. Also referred to as granules.

Blast-furnace slag: The non-metallic product, consisting essentially of silicates and aluminosilicates of calcium and other bases, which is developed in a molten condition simultaneously with iron in a blast-furnace.

Blast-furnace: A furnace used to reduce raw materials into molten iron. Combustion is forced with pressurized air.

Air-cooled blast-furnace slag: The material resulting from the solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface. (This material can be mined and crushed for use as aggregate in concrete or fill material, but is not cementitious.)

Expanded blast-furnace slag: The lightweight cellular material obtained by controlled processing of molten blast-furnace slag with water, or water and other agents, such as steam or compressed air or both. (This is commonly used as lightweight aggregate and is not cementitious.)

Portland cement: A hydraulic cement produced by pulverizing portland-cement clinker and usually containing calcium sulfate.

Blended cement: A hydraulic cement produced by inter-grinding portland cement clinker with other materials, or by blending portland cement with other materials, or by a combination of inter-grinding and blending.

Portland blast-furnace slag cement: A blended cement consisting of an intimately interground mixture of portland cement clinker and granulated blast-furnace slag or an intimate and uniform blend of portland cement and fine granulated blast-furnace slag in which the amount of the slag constituent is within specified limits.

Hydraulic cement: A cement that sets and hardens by chemical interaction with water and is capable of doing so under water.

Pozzolan: A siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

Glass: An inorganic product of fusion, which has cooled to a rigid condition without crystallization.

SPECIFICATIONS

Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars - ASTM C 989¹

This specification covers three grades of finely ground granulated blast-furnace slag for use as a cementitious material in concrete and mortar. The material described in this specification can be used 1) for blending with portland cement to produce a cement meeting the requirements of Specification C 595 or 2) as a separate ingredient in concrete and mortar mixtures. The material may also be useful in a variety of grouts and mortars.



Slag granules stockpiled and awaiting grinding.



Slag Cement



Microscopic slag cement illustrating its glassy nature



Air-cooled slag aggregate (non-cementitious)

TERMINOLOGY AND SPECIFICATIONS

SPECIFICATIONS

Standard Specification for Blended Hydraulic Cements - ASTM C 595²

This specification pertains to five classes of blended hydraulic cement for both general and special applications, using slag cement, or a pozzolan or both, with portland cement, or portland cement clinker or slag with lime. This specification prescribes ingredients and proportions. The two most common types of blended cement using slag cement are:

- Type IS - Portland blast-furnace slag cement (in which slag constituent is between 25 percent to 70 percent by mass)
- Type I(SM) - Slag-modified portland cement (in which slag constituent is less than 25 percent)

Standard Performance Specification for Hydraulic Cement - ASTM C 1157³

This specification covers hydraulic cements for both general and special applications. It is a specification that defines performance requirements for cement and does not restrict the composition of the cement or its constituents. The specification classifies cements by type, based on specific requirements for general use, high early strength, resistance to attack by sulfates, and heat of hydration. Optional requirements are provided for the property of low reactivity with alkali-reactive aggregates.

Ground Granulated Blast-Furnace Slag as a Cementitious Constituent in Concrete⁴ (Reported by ACI Committee 233)

This report primarily addresses the use of slag cement as a separate cementitious material added along with portland cement in the production of concrete. Other slags derived from the smelting of materials other than iron ores are not discussed in this report. The reader should be aware that the material characteristics described in this report and the recommendations for use pertain solely to slag cement and not other forms or types of slag.

Specifications for Structural Concrete⁵ (Reported by ACI Committee 301)

This specification is a reference standard which the engineer or architect can make applicable to any building project by citing it in the project specifications. The user supplements it as needed by designating individual project requirements. The document covers materials and proportioning of concrete; reinforcing and prestressing steels; production, placing, and curing of concrete; and formwork design and construction. Methods of treatment of joints and embedded items, repair of surface defects and finishing of formed surfaces are specified. Separate chapters are devoted to slab construction and finishing, architectural concrete, mass concrete and materials and methods for constructing post-tensioned concrete. Provisions governing testing, evaluation and acceptance of concrete, as well as for acceptance of the structure, are included.

Building Code Requirements for Structural Concrete⁶ (Reported by ACI Committee 318)

The code portion of this document covers the proper design and construction of structural and plain concrete for buildings. The code has been written in such form that it may be adopted by reference in a general building code. Among the subjects covered are: drawings and specifications; inspection; materials; durability requirements; concrete quality, mixing, and placing; formwork; embedded pipes and construction joints; analysis and design; strength and serviceability; flexural and axial loads; shear and torsion; slab systems; walls; footings; precast concrete; composite flexural members; and prestressed concrete.

As with all concrete mixtures, trial batches should be performed to verify concrete properties. Results may vary due to a variety of circumstances, including temperature and mixture components, among other things. You should consult your slag cement professional for assistance. Nothing contained herein shall be considered or construed as a warranty or guarantee, either expressed or implied, including any warranty of fitness for a particular purpose.

References

1. ASTM C989-99, Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars, American Society for Testing and Materials, West Conshohocken, PA, 2003
2. ASTM C595-03, Standard Specification for Blended Hydraulic Cements, American Society for Testing and Materials, West Conshohocken, PA, 2003.
3. ASTM C1157-02, Standard Performance Specification for Hydraulic Cement, American Society for Testing and Materials, West Conshohocken, PA, 2003.
4. ACI 233R-95, Ground Granulated Blast-Furnace Slag as a Cementitious Constituent in Concrete, American Concrete Institute, Farmington Hills, Michigan, 1995.
5. ACI 301-99, Specifications for Structural Concrete, American Concrete Institute, Farmington Hills, Michigan, 1999.
6. ACI 318-02, Building Code Requirements for Structural Concrete, American Concrete Institute, Farmington Hills, Michigan, 2002.

ASTM C989 specifies finely ground granulated blast-furnace slag for use as a cementitious material in concrete and mortar.

Blended cements incorporating slag and portland cement are specified in ASTM C595.



Slag Cement Association
38800 Country Club
Farmington Hills, MI 48331

phone: 847.977.6920
e-mail:
info@slagcement.org
web:
www.slagcement.org

About the Slag Cement Association...

The Slag Cement Association is the leading source of knowledge on blast-furnace slag-based cementitious products. We promote the increased use and acceptance of these products by coordinating the resources of member companies. We educate customers, specifiers and other end-users on the varied attributes, benefits and uses of these products.

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