

ASTM C595, Standard Specification for Blended Hydraulic Cements¹, requires that blended cements consist of an intimate and uniform blend of specified constituent materials. Blended cements are produced by intergrinding portland cement clinker with other specified materials or by blending portland cement with the other materials, or a combination of intergrinding and blending. Binary blended cements contain two constituent materials, while ternary blended cements contain three constituent materials.

How Is Slag Cement Used in Blended Cements?

Slag cement can be used to produce blended cement that complies with ASTM C595¹. The ASTM C595 type designation naming practice for binary and ternary blended cements containing slag cement identifies the blended cement constituent material content as illustrated in the following examples:

- Type IS(35) = 65% portland cement + 35% slag
- Type II(S25)(P15) = 60% portland cement + 25% slag + 15% pozzolan
- Type II(25)(L10) = 65% portland cement + 25% slag + 10% limestone.

These cements are often produced by blending the pre-ground constituents at the cement plant, or in terminals equipped with blending equipment.

Blended cements produced by intergrinding of the constituent materials use granulated blast-furnace slag, the glassy granular material that results in slag cement when ground to a fine powder. Slag granules are added to the grinding mill along with portland cement clinker and the materials are ground simultaneously.

Slag cement has also been used as a constituent in hydraulic cements produced under ASTM C1157, Standard Performance Specification for Hydraulic Cement.²



Figure 1: IS blended cement (33% slag content) was used to produce a noticeably lighter concrete masonry unit on the right



JFK Airport utilized a Type IS, 40% slag cement mixture

What Are the Benefits of Blended Cements?

Blended cements can be produced to provide the performance benefits that are also available when slag cement is used as a separate component of the concrete mix. By varying the proportions of the blend, attributes such as sulfate resistance and resistance to alkali silica reaction can be attained with a blended cement. A blend designed for a specific project requirement can also be produced. For concrete producers, blended cements may allow them to take advantage of the benefits of slag cement or the addition of a third component despite storage constraints.

Can Other Materials Be Used with Blended Cements?

Concrete can be produced with a binary blended cement containing slag plus other cementitious materials (most commonly fly ash or silica fume) added at the batch plant. These are considered ternary systems. Ternary systems can be designed to attain performance characteristics that may be difficult to achieve in a binary system.

How Are the Cements Blended?

There are several systems that are used to make blended cements. Some systems are capable of “on-demand” blending, while others may blend the materials at a fixed percentage into a truck or storage silo. In most cases proportions can be adjusted to produce blends that optimize the desired properties in concrete.

References

1. ASTM C595-19, “Standard Specification for Blended Hydraulic Cements,” ASTM International, West Conshohocken, PA, 2019.
2. ASTM C1157-17, “Standard Performance Specification for Hydraulic Cement,” ASTM International, West Conshohocken, PA, 2017.

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.