Beyond Blocks and Bricks

Number Twenty-three

Ronald J. Hunsicker
Professional Engineer
Masonry Investigations
P. O. Box 6615
Wyomissing, PA
19610-6615
484-332-1164
rjhpe@ptd.net

C216 and fly ash bricks

There is no ASTM standard specification for fly ash bricks.

With no standard for their product, manufacturers of fly ash bricks usually test their products according to the test methods described in ASTM C67. Then, the results of this testing are compared to the requirements for clay brick found in ASTM C216, Grade SW.

If the results of testing of fly ash bricks are within the limits for Grade SW clay bricks, a seller might argue that fly ash bricks are suitable for the same uses as clay bricks. Fly ash bricks might also be touted as being "better" than clay bricks because the results of testing the fly ash bricks are "better" than those for some or all clay bricks.

C216 was developed for clay bricks

The requirements of ASTM C216 were developed specifically to assess the qualities of masonry units which are "*…manufactured from clay, shale, or similar naturally occurring substances and subjected to a heat treatment at elevated temperatures (firing)*."

Because fly ash bricks are not manufactured from clay or shale and are not exposed to elevated temperatures (2000° F), be very wary if the results of testing of fly ash bricks are compared to the requirements of ASTM C216, Grade SW.

Measuring durability

The measures of durability found in ASTM C216—compressive strength, cold water absorption, hot water absorption, and saturation coefficient—were established in the 1930's when the National Bureau of Standards (NBS) tested large numbers of clay bricks and compared the results of this testing to the durability of the same bricks exposed to the weather.

Because fly ash bricks are not manufactured from clay or shale,

- It is unlikely that the 3000 psi minimum average compressive strength requirement found in Table 1 of C216 also applies to fly ash bricks.
    - The compressive strength requirement is present because it suggests a certain level of heat treatment (fired bond) and thus, durability. 3000 psi is not "magic" for all materials; it is only important (and relevant) when testing fired clay bricks.
- It is unlikely that the 17% maximum limit on hot water absorption found in Table 1 of C216 also applies to fly ash bricks.
    - When the hot water absorption of clay bricks exceeds 17%, the NBS testing suggested that the bricks will not be durable. **<u>IF</u>** there is a similar upper limit for hot water absorption for fly ash bricks, this limit has not been established by testing. (Maybe hot water absorption has nothing to do with the durability of fly ash bricks.)
- It is unlikely that the 0.78 maximum limit on saturation coefficient found in Table 1 of C216 also applies to fly ash bricks.
    - The NBS found that many clay bricks with a saturation coefficient in excess of 0.78 were not durable. Such a relationship may or may not exist for fly ash bricks. If there is such a relationship is it likely that the limit will be 0.78 too? Probably not.
- It is unlikely that the relief from the requirements for saturation coefficient found in the Absorption Alternate (Paragraph 6.1.2 of C216) also applies to fly ash bricks.
    - When the cold water absorption of bricks is less than 8%, the NBS found that the bricks will likely be durable. Are fly ash bricks likely durable when their cold water absorption is less than 8%? Or is it 6%? Or 10%? What if fly ash bricks are only durable when their cold water absorption is **greater than 8%?**

Parameters that predict the performance of clay bricks likely will not predict the performance of fly ash bricks, too.

While compressive strength as a measure of durability, cold water absorption hot water absorption, and saturation coefficient **may be** helpful in defining the durability of fly ash bricks, whether they actually **are** appropriate for defining the durability of fly ash bricks is unknown. If they are appropriate, the numerical limits are unknown and will be unknown until sufficient research is done to 1) establish that relationships exist among durability and the other qualities of fly ash bricks and 2) discover the proper numerical values associated with these relationships.

Now what?

What can be claimed? Although there is no standard specification for fly ash bricks, there are standard tests that may offer helpful information:

- **Compressive strength: Testing according to C67 methods.** Regardless that meeting the requirements for compressive strength does not suggest that a fly ash brick will be durable, compressive strength testing can show that the fly ash bricks are strong. Higher (or a certain) compressive strength is useful when the masonry is loadbearing. If the masonry units are to be part of a veneer, compressive strength is not relevant.
- **Initial rate of absorption (suction): Testing according to C67 methods.** IRA is a surface characteristic. IRA helps the mason chose a mortar which will give good bond. Testing fly ash bricks for IRA may help a mason choose mortar proportions.
- **Efflorescence: Testing according to C67 methods.** Efflorescence is a bad thing. This test should (and does) extract soluble salts from almost any masonry material with a smaller pore structure. It may work for fly ash bricks, too.
- **Freeze-thaw resistance: Testing according to C67 methods.** While there is no standard that states that passing a 50-cycle freeze-thaw test shows that fly ash bricks are durable, surviving 50 freeze-thaw cycles is a rigorous test.
- **Bond strength: Testing according to the bond wrench test, C1072.** The bond wrench test is a measure of how well the mortar adheres to the bricks. If a mortar meeting the requirements of ASTM

C270 Type “N” or Type “S” does not stick to a particular brick, the particular mortar and the particular brick may be incompatible. If **no** mortar sticks to a particular brick, the brick may be unsuitable for its intended purpose—being used as a masonry unit. It is important to discover if mortars bond properly to fly ash bricks.

- **Extent of bond via a water penetration test: Testing according to E514.** A mortar that adheres to fly ash bricks well—and provides high bond strength—may not be sufficiently plastic and may not fill all the nooks and crannies in the system. Because the presence of nooks and crannies—voids—greatly increases water penetration, observations of minimal water penetration during a water penetration test can suggest that a brick/mortar combination is working as we expect.