

# New evidence of fire resistance in blended CMUs

*Recent research confirms that producers can blend lightweight and normal-weight aggregate in their block mix designs and achieve required fire ratings*

Offering customers lightweight concrete masonry units is becoming less of a value-added marketing strategy and more of a necessity for producers. In booming market segments such as schools, designers often require minimum 2-hour fire ratings, while masons want more productivity and less physical strain.

Even though block producers have blended normal-weight sand with lightweight coarse aggregate for years, many have assumed that they could promote fire resistance only with 100% lightweight aggregate units. For many producers, the costs of the lightweight aggregate itself and of transporting it have made production of 100% lightweight units unfeasible, effectively shutting them out of projects in which specifiers want a fire rating or contractors want lighter units.

In response, a couple of lightweight



Witelite by Tarmac

Testing proves blended block of all shapes and sizes meet fire ratings.

aggregate suppliers are using testing to prove that blended units meet fire-resistance requirements, enabling masonry to earn a bigger piece of the construction market.

## Blending a better block

The new International Building Code has adopted ACI 216.1/TMS 0216.1, “Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies.” It provides for blending aggregate as long as the unit meets the fire rating in actual testing or if it is cast with a minimum equivalent thickness for a blended unit, calculable using weighted averages found in Table 3.1 of the standard.

To calculate the equivalent thickness

of a 50/50 blended pumice/natural sand unit to achieve a 2-hour fire rating, for example, establish the dry-rodded weight of the aggregates to accurately calculate volumes. Then add the weighted averages to get the required equivalent thickness (see example at left).

Using this method, two lightweight aggregate suppliers have achieved Underwriters Laboratories certification—required in many markets by architects specifying fire-resistant masonry—for blended units.

Last year Witelite by Tarmac of Chesapeake, Va., supplier of a proprietary brand of pumice imported from Greece, had several units with various aggregate-blend ratios and equivalent thicknesses fire-tested per ASTM E-

## Calculating equivalent thickness for blended block

Equivalent thickness of a 100% pumice unit: 3.2 inches

Equivalent thickness of a 100% sand unit: 4.2 inches

$$(3.2 \times 0.50) + (4.2 \times 0.50) = 3.7 \text{ inches}$$

per ACI 216.1/TMS 0216.1

119 by UL (Table 1, page 26). The goal was to validate the ACI 216.1/TMS 0216.1 calculation method of blending aggregate, says Dave Miller, manager of technical marketing.

Augusta Concrete Block of Hamburg, S.C., recently switched its lightweight aggregate supply to the Tarmac material, and the research enabled it to hit the ground running with a new fire-rated block, says Jim Farmer, president. "We've campaigned architects to specify UL fire-rated block," he says. "I have plenty of jobs that have 50,000, 100,000 fire-rated block, and when you're able to use blended units and they've been approved, that's a big savings right there."

Not far away, Big River Industries of Alpharetta, Ga., a supplier of rotary-kiln expanded clay, developed in the early '90s a proprietary mix design for fire-rated lightweight block that uses a 70/30 blend. "Our goal was to enable our customers to use our mix design on a blended unit so they didn't have to go out and do a fire test every time they wanted to make a blended unit," says Jeff Speck, vice president of engineering.

For Big River Industries' customers to provide a UL certificate on a lightweight-specified project, their block had to use 100% lightweight aggregate, undergo a fire test at UL, or, if a blended mix, meet the equivalent-thickness requirements of normal-weight block per ACI 216.1/TMS0216.1. Choosing the second option, Speck wanted the flexibility to design the mix with either natural sand, crushed limestone, or crushed granite along with the lightweight aggregate. If a blended mix including natural sand passed the test, any of the fines would be acceptable.

"We ran our initial fire test (Table 2), and the natural-sand combination, which was high in silica, had the [smallest] safety margin," Speck says. "We fire-tested that 70/30 blend on an 8-8-16 that had a 3.8-inch equivalent thickness, and the blend with limestone and the blend with granite went well beyond 2 hours, and the one with natural sand went just beyond 2 hours." Dan Quinn, vice president at

**Table 1. UL fire testing of a 50/50-blended pumice/sand concrete block\***

Size	Unit			
	Pumice lb/cy	Sand lb/cy	Cement lb/cy	Equip thickness
8x8x16	2,520	4,150	740	3.8 in.
Target	Test			
	Max avg temp to pass ambient + 250° F	Actual avg temp/time	Max single pt to pass amb. + 325° F	Actual temp/time
2 hr	333° F	333° F 2 hr 7 min	408° F	408° F 2 hr 6 min

\*Percentages by volume. Actual dry-rodded weights were 48% pumice, 52% sand.

Source: Witelite by Tarmac

In spring 1998 Witelite by Tarmac had a UL fire test conducted on several concrete masonry units with varying volumetric ratios of sand and its proprietary brand of imported pumice. All the units met test targets, including a unit with the highest sand percentage (50/50), which met the 2-hour target.

**Table 2. UL fire testing of Big River Industries' blended concrete block**

Unit Size	Unit			
	Equip thickness	Aggregate*	Cement/agg ratio*	
8x8x16	3.8 in.	70% expanded clay, 30% natural sand	1:9	
Target	Test			
	Max avg temp to pass ambient + 250° F	Actual avg temp/time	Max single pt to pass ambient + 325° F	Actual temp/time
2 hr	320° F	320° F 2 hr 8 min	395° F	395° F 2 hr 8 min

\*Volumetric measurement, based on dry-rodded unit weights of material.

Source: Big River Industries Inc.

In 1991 Big River Industries, Alpharetta, Ga., conducted full-scale UL fire tests on blended concrete masonry units using several different normal-weight aggregates. All the units, including one cast with natural sand that had the highest silica content, met the 2-hour test target.

Atlanta-area producer RMC Allied Ready Mix, adds that the mix "produces an 8-inch block that's 23 pounds; our regular 8-inch block is 28 pounds."

#### Allowing a wholesale switch

With the fire-resistance hurdle cleared, Mundelein, Ill.-based Northfield Block, a leading Chicago-area block producer, is launching a gradual,

wholesale switch from normal- and medium-weight units to blended lightweight ones using Witelite by Tarmac's pumice aggregate. To quantify to masons and architects the value-added benefits of lightweight units, Northfield Block sales representatives are handing out a two-page flyer titled, "Protecting the Future of Masonry: Lightweight Masonry Units." The flyer lists increased productivity, lower

workers' compensation costs, shorter construction time, safer scaffolding, and easier cutting with its lightweight units. For architects, the flyer emphasizes lightweight block's thermal resistance, strength, durability, fire ratings, and contribution to lower construction costs.

"I think for our future as a company, we need to look at new products, including lightweight products, for our whole industry," says Jeff Hunt, sales manager. "When we came up with a mix design where we could take 10 pounds out of an 8-inch block and still have the durability to meet ASTM C 90 and make it cost-effective for the basic contractor, that became very exciting to us. Our 12-inch block is 33 pounds—that's less than an 8-inch block that's currently in the marketplace; we're cutting 14 pounds out—that's exciting." ■



The proven fire resistance of blended block is enabling Northfield Block Co., Mundelein, Ill., and managers (left to right) Jeff Hunt, Steve Hunt, Riley Fulmer, and Jenny Hunt to make a complete switch to lightweight units.

—DON TALEND

### Reference

ACI/TMS Committee 216, "Standard Method for Determining Fire Resistance of Concrete and Masonry Con-

struction Assemblies," ANSI/ACI 216.1-97, TMS0216.97, *ACI Manual of Concrete Practice*, 1999, American Concrete Institute, Farmington Hills, Mich.

Publication #J99L025

Copyright© 1999, The Aberdeen Group,  
a division of Hanley-Wood, Inc.  
All rights reserved