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HOW TO MAKE THE MOST OF FAST-SETTING CONCRETE

Mixes made with belitic calcium sulfoaluminate (BCSA) cement provide a competitive edge if you know how to exploit the material's advantages.

> *Repairs can be quickly returned to service with near-zero shrinkage.*

Wouldn't it be great to work with a mix that doesn't shrink and reaches 3000 psi compressive strength in about two hours? That's what you get with concrete made from belitic calcium sulfoaluminate (BCSA) cement, an alternative to portland cement that has a proven track record of success in various applications. Repairs can be quickly returned to service with near-zero shrinkage, enabling contractors to deliver durable and crack-free projects.

However, concrete made with BCSA cement isn't a miracle—it requires know-how to place effectively. The key is learning how to take advantage of and control the material's unique properties.

What Makes the Material Unique

BCSA cement has been around since 1975. Its hydration reaction consumes all the free water at a very early age in the creation of ettringite crystals. This means flatwork doesn't bleed and therefore pores and capillaries are much smaller than those created in portland cement concrete by rising bleed water. The result is lower permeability and very low drying shrinkage.

Many in the industry consider ettringite a negative ingredient because "delayed ettringite formation," frequently a result of high concrete temperatures or exposure to sulfates, causes deterioration. However, ettringite formation in BCSA cement happens so early in the hydration process that no delayed formation occurs.

The primary manufacturer of BCSA cement is CTS Cement Manufacturing Corp. in Garden Grove, California, which markets the material as Rapid Set. It's available in prepackaged bags of mortar and concrete for repair projects. For larger projects, producers can get the cement in bulk and deliver the concrete in standard mixer trucks or, more commonly, using volumetric mixers.

The most commonly cited disadvantage of BCSA cement is the cement cost, which can be three times that of portland cement. However, in applications that require rapid return to service and durability, overall project cost is typically lower. Concerns about the rapid setting are easily overcome by being well-prepared on the jobsite.

WORKING IT

Surface preparation is identical to surface preparation for any repair and just as essential for success. Damaged concrete must be removed, the matrix must be free of contaminants and dust, and reinforcing steel must be free of rust. If additional steel is needed to replace steel that has lost too much cross section or if dowels are to be used, those need to be in position before beginning work.

With its very rapid strength gain, BCSA cement concrete is most often produced using volumetric mixers. CTS Cement Eastern Regional Sales Manager Chris Davis has seen it made in a central mix plant that was onsite at an airport installation and has also had the aggregate mix sent to the site without cement. "For a repair at the mouth of the Lincoln Tunnel, the producer sent a sand and stone mix to the jobsite and BCSA cement was added onsite," he says.

GIVEN HOW QUICKLY IT SETS, THE CONTRACTOR MUST HAVE EVERYTHING READY BEFORE MIXING.

"Installation is pretty similar to regular concrete except there's only 20 minutes of working time," Davis says. For smaller installations, portable drum mixers or drill-mounted paddle mixers are appropriate and mixing should take one to three minutes. Follow the manufacturer's directions for amount of mixing water and never retemper the material.

There will be little to no bleeding, so curing is important. Apply the final finish as soon as possible. As soon as the moist sheen dissipates, wet-cure the surface for at least one hour or apply curing compound.

Frequent users say BCSA cement concrete is easy to use compared to portland cement concrete and more forgiving. "I like that it's predictable," says Mike Schilling of East Coast Poured Floors Inc., an underlayment contractor with locations in Baltimore and Orlando, Florida. "But just like with portland cement mixes, you need to control everything: dry mix temperature, water temperature, water amount. We weigh the water rather than measure the volume so it's exact."

As with any cementitious material, safety is an important consideration. The Occupational Safety and Health Administration takes dust protection requirements very seriously. Dry BCSA cement can release respirable silica dust, so wear an APF 10 respirator when handling the powdered material. The wet material is alkaline like portland cement concrete, so wear waterproof gloves, eye protection, and skin protection.

BEYOND REPAIR: PUBLIC PROJECT APPLICATIONS

The California Department of Transportation (Caltrans) first used BCSA cement concrete after a 1994 earthquake to repair two collapsed overpasses. After that, Caltrans began using BCSA cement concrete for its individual slab replacement (ISR) program, which requires overnight replacement of damaged pavement sections. CTS Cement estimates the state has placed nearly 1,000 lane-miles of the material.

"We used to use Rapid Set only for repairs, but more and more we're pouring it for structural applications like bridge decks," says Matt Murphy, president of Precision Concrete Materials in West Sacramento, California, which operates a fleet of volumetric mixer trucks. "Caltrans is getting away from portland cement mixes for bridge decks, joints and hinges, freeway panels, and approach slabs. Occasionally, we'll even do barrier rails."

One recent example is hinge replacement on an I-280 bridge that carries traffic to and from San Francisco. To minimize disruption on such a major artery, work was done over three holiday weekends in summer 2014. To prepare, Golden State Bridge Inc. in Benicia, California, and Precision Concrete Materials built a 16-cubic-yard mockup six weeks before bridge closure. The concrete was made in volumetric mixers and pumped to simulate the onsite set-up.

The dress rehearsal paid off. Real-life closures were limited to 100 hours during which 25 feet to 30 feet of the bridge on either side of each hinge was demolished; formwork and prefabricated reinforcing steel cages positioned; and 130 cubic yards of Rapid Set placed, finished, and cured. The concrete had compressive strength of 1200 psi in three hours and 3500 psi in four hours and the bridge reopened well before the required time. Hinges now have an estimated service life of 60 years and, after four years, exhibit no distress.

"I regularly travel over it and as far as I can tell there are no stress cracks on the surface, although I haven't been able to inspect the underside of the hinge replacements," says Caltrans Bridge Construction Manager Roberto Luena.

For contractors, BCSA cement and the rapid-setting concrete it makes, provide an advantage when the job needs to be done quickly and the repair needs to be durable. Just make sure to have the knowledge and experience to be able to handle this fast-setting material.

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CTS Cement Manufacturing Corp. is the leading manufacturer of advanced calcium sulfoaluminate (CSA) cement technology in the United States. Our Komponent® and Rapid Set® product lines are renowned for proven performance, high quality, and exceptional service life. Contact CTS Cement for support on your next project. Call 1-800-929-3030.

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