ARTICLE REPRINT
Durability & Design *May 2016*

BEAUTIFUL FLOORS FAST:

The Benefits of Rapid-Setting Cement Products

Simple white interiors and natural light welcome visitors in the Contemporary Art + Design Wing at the Corning Museum of Glass in Corning, NY. (See Project 2, below.)

For decades, portland cement has been the standard for concrete floors, but the material presents a number of challenges, including excessive shrinking and slow set times. It can't be accelerated without negative effects, is susceptible to attack by prevalent chemicals and reacts destructively with certain aggregates. One way to solve these problems is by using calcium sulfoaluminate (CSA) cement.

CSA cement-based overlays allow architects and contractors to produce beautiful, flat, polished floors in a fraction of the time it would take with portland cement—and at considerably lower cost. With portland cement concrete, old floors would typically have to be torn out and replaced with new concrete—a costly process. CSA overlayments, however, allow for quick repairs without the expense of constructing entirely new floors.

CSA cements are manufactured with similar raw materials, equipment and processes used to make portland cement. The chemistry includes calcium sulfoaluminate (C_4A_3S) and dicalcium silicate (C_2S). The C_4A_3S compound hydrates to form beneficial ettringite—a strong, needle-like crystal that forms very quickly, giving the material its speed and high early strength properties.

Another significant aspect of the chemistry is the absence of tricalcium aluminate (C_3A), which is present in portland cement and makes that material susceptible to sulfate attack. The fact that CSA cement products have little or no C_3A makes it very durable in sulfate environments.

When CSA cement is used in concrete, it results in superior performance in terms of rapid strength gain, reduced permeability and low shrinkage. CSA cement is highly versatile and used to formulate mixes for a wide range of applications. Properties, including setting time, fluidity, air content and color can be adjusted easily using commercially available additives. While lighter in appearance, integral color may be added to CSA-based concrete to match the look of portland cement concrete.

The following three projects illustrate the value of using advanced high-performance CSA cement products to meet the aesthetic needs of each job in a timely manner.

PROJECT 1: REIMAGINING THE COLLEGE BOOKSTORE

The University of Massachusetts Amherst partnered with online retailer Amazon.com to offer a virtual bookstore, which provides free, one-day shipping to campus addresses and nearby communities. To support this collaboration, Amazon also planned to open an on-campus customer pick-up and drop-off location.

The distribution center would include high-tech features, such as automated package pick-ups, in which students can open coded lockers to retrieve deliveries. Constructed in a converted third-floor textbook annex, the completed facility would be subject to foot traffic in the ordering area, as well as pallet jacking in the supply room.

This textbook distribution center at University of Massachusetts Amherst offers high-tech features, such as automated package pick-ups and coded lockers for deliveries.

The distribution center's contemporary, polished concrete floor is subject to foot traffic in the ordering area, as well as pallet jacking in the supply room.

> *To meet this timeframe, the contractor chose a CSA cement product because it sets quickly and achieves high strength in one day.*

Contracted to restore 1,200 square feet of existing flooring, Tri-State Underlayments/ Franz Floors Ltd. of Waterbury, Conn., had only four days to complete the work before interior framing began. To meet this timeframe, the contractor chose a CSA cement product because it sets quickly and achieves high strength in one day.

MANAGING SET TIME AND FLUIDITY

The contractor used 550 bags of CSA-based concrete mix to place 3- to 5-inch infill slabs. The mix—a blend of CSA cement and quality aggregates—provides low shrinkage and superior durability, and sets in 15 minutes. Tri-State had to make sure the concrete would not harden too fast, however, since the project took place in May during temperatures of 80 to 85 degrees Fahrenheit.

The crew started every pour with 20 pounds of ice in the mix water and used a set retarding admixture. The admixture helped slow down the setting time, giving the contractor more time to place and finish the concrete. For increased fluidity, the contractor also used a superplasticizing admixture. The concrete was mixed and placed via a truck-mounted mixer pump that could pump 100 bags an hour to the third floor. The slabs were then screeded and wet-cured.

Before Day 2 ended, the fast-setting concrete was ready for a primer. The contractor used a high bond-strength epoxy primer to prevent pinholes, in a one-coat application at 12 mils (0.3 mm). The two-component primer is also low-VOC and moisture- and alkali-insensitive. The contractor broadcast silica sand into the primer to ensure good adhesion with the floor topping, and removed the excess sand the following morning.

TOPPING AND POLISHING

On Day 3, the crew applied a CSA cement-based, self-leveling topping. The one-component topping levels rapidly and maintains workability for 30 minutes, producing a smooth, strong surface with high bond strength.

For this project, the contractor applied the topping at a half-inch thickness (500 mils/12.7 mm). The first 100 bags of self-leveling topping were mixed with two percent charcoal integral color and placed via the truck-mounted mixer pump. The last 30 bags were mixed by portable batch mixer.

The topping was ready for foot traffic in 2-3 hours and could be coated in about 12 hours. The adhesion of epoxy primer and self-leveling topping is designed to remain unaffected by moisture vapor transmission and alkalinity up to 14 pH.

The dry polishing process began on Day 4. Grinding machine operators started with 30/40-grit metal bonded diamonds and continued through 1,500-grit resin pads. Finally, the contractor applied a stain guard and burnished it into the surface.

The end result is a polished concrete floor that complements Amazon's contemporary, high-tech distribution center on the Amherst campus.

PROJECT 2: INSPIRING BEAUTY

In 2015, the Corning Museum of Glass in Corning, N.Y., opened its Contemporary Art + Design Wing. The wing provides visitors with a day-lit environment in which to experience contemporary art and design in glass from the past 25 years. At a cost of $64 million, the 100,000-square-foot expansion includes 26,000 square feet of gallery space and a 500-seat facility for live glass blowing demonstrations.

The building facade is constructed of large, white glass panels, creating a nearly seamless, softly reflective expanse. The inside of the building features a simple, white interior. The galleries are defined by massive, curved concrete walls that support the skylight roof. Concrete beams rest on the curved gallery walls and diffuse the light as it comes through the skylights, directing it onto the concrete floor where the glass is displayed.

The architect wanted an extremely light gray concrete floor for subtle contrast to the bright-white plaster walls. The original design specified a slag cement mix to provide that color, but the ready-mix supplier was unable to provide it within the required time frame. Waiting for that particular product would have jeopardized project scheduling and completion time. The hunt was on for a solution.

COLOR MATCHING WITH CUSTOM PIGMENT

After several unsatisfactory concrete slab mock-ups, contractor DJ Rossetti Inc. of Malta, N.Y., recommended using a CSA cement-based, self-leveling topping with integral color. This advanced CSA cement-based product is crack-resistant and durable, and may be used as a self-leveling topping, resurfacer and underlayment. For this particular project, it served as a polishable topping.

The one-component system cures to a light off-white color that is ideal for stained, dyed or integrally colored floors. With the addition of custom pigment, it cured to a very light gray (almost white) that was perfect for the light-filled space and achieved the architect's desired look.

PREPARATION AND APPLICATION

Before installing the self-leveling topping, the DJ Rossetti crew first prepared the surface by using a grinder with 25-grit metal diamonds. Next, they applied a two-component moisture- and alkali-insensitive epoxy primer. A one-coat application of this low-VOC primer sealed the porous concrete, allowing the floors to be installed in 12 hours. The contractor also broadcast 20/40 mesh sand to increase adhesion to the topping.

Crew members then placed the self-leveling topping and used spike rollers to release any trapped gas. This topping rapidly levels and maintains workability for 30 minutes. For this 26,000-square-foot project, they used 1,850 bags of product, which was mixed via portable mixer and placed at three-eighths-inch thick.

POLISHING PROCESS

Since the architect wanted a low-sheen finish, the contractor used a grinding machine with diamond tooling to polish the concrete. The crew first used 80-grit metal, then 150-grit metal before moving onto 50-grit resin and finally 100-grit resin.

The result: refined concrete flooring that acts as a sophisticated canvas for the museum's glass art.

PROJECT 3: FINISH FOR A HIGH-END SHOWROOM

Bonsai Group needed a unique, eye-catching showroom floor to complement its expanding line of high-quality furniture and fittings. The company is located in Guernsey, an island in the English Channel off the coast of Normandy. Originally an installer of hand-finished, bespoke timber floors, Bonsai Group now offers complete interior design services, as well as exclusive furniture and wall and floor coverings.

The company had a clear vision for the showroom's 400-square-foot concrete floor: a two-tone, cloudy look with a high shine. Steve Peck Stone Restoration of Holsworthy, England, was tasked to provide a polished concrete floor that would be both tough and decorative.

TWO-TONE STAINING TECHNIQUE

The contractor chose a CSA cement-based self-leveling topping that's crack-resistant, durable and won't deteriorate in damp conditions. Peck's crew poured the one-component system at a depth of 12 mm and left it to cure for 24 hours. After the floor cured, they used two grinding machines equipped with 40-grit metal diamonds to remove the skin of the slab and open the surface.

To ensure substrate adhesion and high durability for the base color, crew members added four gallons of a blended-silicate-

The one-component CSA cement-based topping system cures to a light off-white color, and may be stained, dyed or integrally colored. Adding custom pigment achieved a very light gray that was perfect for the light-filled space.

The architect wanted an extremely light gray concrete floor for subtle contrast to the bright-white plaster walls. A CSA cement-based topping was combined with integral coloring, and polished to a low sheen.

solution densifier to one gallon of a water-based stain. The stain, a natural light gray, was applied evenly with a microfiber mop. Once the first coat dried, they used a garden sprayer to apply a second coat of darker, antique gray stain. This technique produced a cloudy, splattered effect.

The crew then polished the floor starting with a 400-grit diamond-encrusted pad, followed by 800-, 1,500- and finally 3,000-grit. Next, they mopped the area with clean water to remove any fine powder and particulates.

PROTECTIVE, HIGH-GLOSS COATING

To protect the floor, the contractor applied two coats of guard—a water-based, cross-linking acrylic coupled with a polyurethane polymer to provide exceptional abrasion and wear resistance. Crew members applied the guard with microfiber mops, allowing it to dry to the touch between coats, then used a high-speed buffer at a minimum of 1,500 rpm to burnish the area with a hog-hair floor pad. Next, the contractor applied two coats of acrylic polish, allowing it to touch-dry between coats, and finally burnished the floor with a white pad to achieve the desired high-gloss finish.

The project was completed in three days. The result is a show-stopping stained and polished concrete floor that sets the stage for Bonsai Group's exquisitely made furniture.

This beautiful concrete floor was finished with a two-tone, cloudy look and polished to a high shine. Contractors completed the work in just three days, using CSA cement-based products. Photo courtesy of Specialised Tools & Machinery (STM) LTD.

Top: Contractors installing a CSA cement-based self-leveling topping. The one-component system was poured at a depth of 12 mm and cured for 24 hours. Bottom: The floor was finished with two coats of acrylic polish and burnished with a white pad to achieve a high gloss. Photos courtesy of STM LTD.

CREATING BEAUTIFUL, DURABLE FLOORS – FAST

As these three projects illustrate, calcium sulfoaluminate (CSA) cement-based products are highly effective materials to use when facing the need to meet aggressive timetables, reduce costs and achieve high quality results. These materials have far more rapid set times than portland cement, and allow for a range of architectural touches and decorative finishes, including colored and polished overlays.

Additionally, by repairing damaged concrete with the high performing CSA cement products, floors no longer need to be torn out, saving time and expense. These materials offer new solutions for architects and contractors pursuing economical and sustainable paths to their renovations.

About the author: Jose Ruiz is the eastern regional manager of packaged products for CTS Cement Manufacturing Corp. (Cypress, Calif.) and has been involved in the concrete construction and restoration industry for more than 20 years. Ruiz joined CTS in 2008 and has been instrumental in the company's expansion and growth. As a regional manager, he works with the sales team to expand market growth and manage product sales. Ruiz also works closely with construction industry leaders and construction material suppliers to provide support and solutions for their everyday projects. He can be reached at jruiz@CTScement.com.

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

Original publication: Ruiz, J. (2016, May). Beautiful Floors Fast: The Benefits of Rapid-Setting Cement Products. Durability & Design.