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JANUARY/FEBRUARY 2018

PRECAST INC.

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Precast Inc. (ISSN 1940-9184 print, ISSN 1940-9192 online) is published bimonthly by NPCA.

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NPCA is a trade association representing the manufacturers of plant-produced concrete products and the suppliers to the industry around the world.

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Camp Precast Concrete Products' new facility positions them for continued growth.

WORK WITH FAMILY?

Exploring the **highs and lows** of working in a **family-run** business.

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On the Cover:

Workers place a rebar cage in a 8,000 gallon tank with a protective Agru liner at Camp Precast Concrete Products in Milton, Vt.

photo by Sara Geer

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Questions from the **Field**

Questions from the Field is a selection of questions **NPCA Technical Services engineers** received from calls, emails and comments on blog posts or magazine articles on precast.org.

If you have a technical question, contact us by calling (800) 366-7731 or visit precast.org/technical-services.

Terry writes:

Would using a water mister directly on a product after producing polymer-concrete channels aid in the reduction of crazing or cracking?

NPCA Technical Services engineers answered:

In order to provide a thorough response, we would need more information on the formulation used in your polymer concrete. In general, polymer concrete is a composite material in which the aggregate is bound together in a matrix with a polymer binder. Most times, these composites don't contain hydraulic cement; however, portland cement can sometimes be used as an aggregate or filler. Polymer concrete composites possess a unique combination of properties dependent on the formulation, so it's impossible to assess performance or give proper advice without knowing additional details. ACI 548.1R-09, "Guide for the Use of Polymers in Concrete," may provide some information on specific manufacturing procedures.

For hydraulic, cementitious-based precast concrete, fine map cracking, commonly referred to as crazing, is usually caused by surface shrinkage. Anything that can cause rapid surface drying, such as low humidity, high air temperatures or wind, can cause crazing. To help prevent crazing in this type of concrete, curing procedures should include processes that maintain a high level of humidity. Misting portland cement concrete provides excellent curing conditions by maintaining humidity levels that are ideal for proper hydration. It also slows evaporation from the concrete surface and reduces the potential for plastic shrinkage cracking. It should only be used when the air temperature is above freezing and once the concrete has achieved sufficient setting to avoid damaging finishes and potentially raising the water-cementitious ratio. Intermittent misting should be avoided if the concrete surface is allowed to dry between periods of wetting.

Mike writes:

What temperature and moisture levels are required for the curing process?

NPCA Technical Services engineers answered:

Assuming you're talking about conventional portland cement concrete, the ideal temperature and moisture levels will vary based on many factors. Generally, concrete temperature should fall between 50 and 70 degrees Fahrenheit and relative humidity should exceed 80% to 85%. This would apply to conventional curing and not accelerated curing processes. The reaction between cementitious materials and water, otherwise known as hydration, is a series of chemical reactions. The rates of those reactions are temperature dependent. The rate of reaction can double for each 18 F rise in concrete temperature. Low concrete temperatures can result in stunting the hydration process. Higher concrete temperatures can result in faster strength gain at early ages, but lower ultimate strength at later ages. A study by Paul Klieger in Portland Cement Association Research Bulletin 103 concluded that Type I portland cement concrete cured at about 55 F for the first 28 days ultimately reached the highest strength. Again, these ideal conditions will depend on many factors including what admixtures and cementitious materials are used and whether this is a mass structure or thin wall.

When pouring concrete in cold or hot temperature extremes, added precautions need to be employed to ensure quality. Those special guidelines can be found within ACI 305R-10, "Guide to Hot Weather Concreting," and 306R-16, "Guide to Cold Weather Concreting."

David writes:

What is the requirement for concrete slabs that cannot be strapped in the middle, is it two on the end and front or every 10 feet?

NPCA Technical Services engineers answered:

According to the Federal Motor Carrier Safety Administration, "When an article of cargo is not blocked or positioned to prevent movement in the forward direction, and the item is longer than 10 ft in length, then it must be secured by two tiedowns for the first 10 ft of length, and one additional tiedown for every 10 ft of length, or fraction thereof, beyond the first 10 ft... If an article is blocked, braced or immobilized to prevent movement in the forward direction by a headerboard, bulkhead, other articles that are adequately secured, or other appropriate means, it must be secured by at least one tiedown for every 10 ft of article length, or fraction thereof."

If the slabs will crack under those requirements, then this should be brought up with the company's quality control manager. According to Section 4.8.4 in the NPCA Quality Control Manual for Precast Concrete Plants, "Trucks and other conveyances used to transport precast concrete products from the plant to the location designated by the customer shall be equipped and maintained to deliver those products without damaging them to the extent that they must be repaired or rejected."

In short, if the slabs are longer than 10 feet in length, they must be secured by at least one tiedown every 10 feet. If the slab is not braced to prevent forward movement, then it must have two tiedowns in the first 10 feet as well as a tiedown every 10 feet afterward. **PI**

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Testing FRESH CONCRETE PART 2

Following **ASTM standards** for testing wet-cast fresh concrete is **critical** for manufacturing a **high-quality precast** concrete product.

By Mitch Rector

Editor's Note: *This article is intended to serve as a reference guide for entry-level production workers. This second article of the series explains the basics of slump-flow testing, air content testing and creating concrete cylinder test specimens.*

Testing your concrete is a lot like going to the doctor for a check-up. Being proactive about your concrete's quality even when there are no detectable issues is important just like an annual physical. But how would you feel if during your check-up the doctor was not paying attention or did not know the proper steps to take? It would probably cause you to feel uneasy and search for a new doctor.

Just like in medicine, knowledge, accuracy and consistency are critical. A quality control technician must diagnose any potential concerns with a concrete mix before they become too big. This is why understanding the proper air content, slump and strength of your concrete is key to delivering a quality precast product.

SLUMP-FLOW TESTING

Admixtures used in self-consolidating concrete allow for highly flowable concrete that can work its way around reinforcement and requires no vibration or consolidation. However, this highly flowable mix cannot be used with ASTM C143, "Standard Test Method for Slump of Hydraulic-Cement Concrete." In these cases, a slump-flow test in accordance with ASTM C1611, "Standard Test Method for Slump Flow of Self-Consolidating Concrete," can be used to monitor the


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consistency of fresh SCC. It is important to know that C1611 is applicable for SCC with up to 1 inch coarse aggregate. C1611 may not be used for mixes with a nominal maximum size greater than an inch. Larger aggregates can inhibit flow and encourage concrete segregation.

The equipment needed for performing a slump-flow test includes:

- A mold that conforms to that described in C143.
- A smooth base plate with a minimum diameter of 915 millimeters.
- A strike-off bar that conforms to ASTM C173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
- A measuring device such as a ruler or rigid measuring tape. This instrument must be able to measure to an accuracy of 1/4 inch.

The slump-flow test should be performed on a level surface. An uneven surface could cause the concrete to flow in one direction instead of evenly. Once all the equipment is gathered, it is time to begin the test.

- Once obtaining a sample of freshly-mixed SCC, you have 5 minutes after obtaining the final portion of the composite sample to start the slump-flow test.
- Dampen the base-plate surface and the interior of the mold.
- Place the mold in the center of the plate. C1611 allows for the mold to be placed either upright or inverted. An inverted mold may be easier to fill, but be sure not to tip it over.
- Fill the mold in one lift with SCC until it's filled slightly above the rim. Do not rod or tap the mold during the slump-flow test.
- Strike off the surface of the mold using the strike-off bar in a sawing motion and remove the concrete from the base of the mold.
- Raise the mold vertically a distance of 9 inches in 3 seconds. Do not twist or rock the mold as you raise it. The test must take no longer than 2 1/2 minutes from the start of filling the mold to the complete removal of the mold. If the time goes over, repeat the test.
- Once the concrete has stopped flowing, measure and record the largest diameter of the spread to an accuracy of 1/4 inch. Then measure the next diameter at a 90-degree angle. If the two diameters differ by more than 2 inches, then the test is invalid and must be repeated.
- The slump flow is calculated by averaging the two diameters.

AIR CONTENT TESTING BY PRESSURE METHOD

Air content is an important part of a concrete mix. Being able to determine the entrained and entrapped air in concrete will help predict how it will behave during freeze-thaw cycles. Entrained air will create microscopic voids that water can travel to during freezing, preventing concrete from cracking. Whatever the target air content is for a mix, you must be able to accurately measure it. One of the primary ways of measuring air content is through ASTM C231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method." This test is applicable for normal and heavyweight concrete with maximum size aggregates no larger than 1 1/2 inches. C231 is not applicable for lightweight concrete or aggregates with high porosity. It is important to know that while C231 features a procedure for Type-A and Type-B air meters, this article covers only the requirements for Type-B meters. C231 can be performed after performing ASTM C138, "Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete," and will begin assuming the technician has completed a C138 density and yield test.

In addition to the equipment needed for C138, the C231 test requires:

- A Type-B air meter consisting of a 0.20 cubic-foot, cylindrical measuring bowl and a cover assembly with an air chamber, pressure gauge and petcock.
- A funnel with a spout for fitting into the spray tube of the cover assembly.

After placing and consolidating a sample for C138, the steps to perform an air-content test include:

- Clean the flanges or rim of the measuring bowl, cover assembly and assemble the apparatus. Close the main air valve and open both petcocks before using a rubber syringe to inject water through one petcock until it emerges from the opposite petcock.
- Close the air-bleeder valve on the air chamber and pump air into the chamber until the gauge hand reaches the initial pressure line. The gauge hand can be stabilized by tapping the gauge by hand.
- Close both petcocks and open the main air valve.
- Tap the sides of the measuring bowl with the mallet and stabilize the gauge if necessary by tapping with your hand.
- Record the air reading percentage on the pressure gauge before releasing the main air valve.

AIR CONTENT TESTING BY VOLUMETRIC METHOD

ASTM C173, "Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method," is notorious among QC technicians for including many steps and for taking a great deal of time

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Air content amount is typically specified in areas where freeze-thaw damage may occur.

to complete. This makes it important to familiarize yourself with the proper procedure to prevent potential mistakes. From a QC standpoint, the main benefit of testing air content by the volumetric method compared to the pressure method is the volumetric method is valid for all types of concrete. From a personal standpoint, the volumetric method provides a great workout.

The equipment needed for a successful air-content test includes:

- An air meter consisting of a 0.075 cubic-foot measuring bowl, top section, watertight clamp and watertight cap. The top section must feature a scale graduated in increments no greater than 0.5% and measure from 0 at the top to 9% of the volume of the measuring bowl.
- A funnel with a spout long enough to be inserted into the graduated neck of the air meter.
- A tamping rod with a 5/8-inch diameter and a length of at least 4 inches greater than the depth of the measuring bowl, but less than 24 inches. The rod must have a hemispherical tip for tamping the concrete.
- A 1/8-inch-thick steel or 1/4-inch-thick polyethylene bar with a height of 3/4 inch and length of 12 inches.
- A calibrated cup equal to 1% of the volume of the measuring bowl.
- A measuring vessel for isopropyl alcohol with a minimum capacity of 1-pint and 4-ounce gradations.
- A rubber syringe able to hold at least 2 ounces of fluid.
- A 1-quart pouring vessel for water.
- A scoop for filling the bowl.
- 70% by volume Isopropyl Alcohol. It is used to prevent foam from building up in the graduated neck during the test. Rubbing alcohol is commonly used as long as it is 70% by volume isopropyl alcohol.
- A 1.25-pound rubber mallet for tapping the sides of the measuring bowl.

Testing using the volumetric method involves shaking and rolling a sample in order to displace air from the concrete specimen where measured. Because you are adding water and alcohol to the concrete during the test, the sample should not be returned to the rest of the concrete.

- Dampen the interior of the measuring bowl and fill with two equal layers of concrete. Each layer must be rodded 25 times. After rodding a layer, tap the side of the measuring bowl with the mallet 10-to-15 times.
- Strike off the excess concrete with the strike-off bar. Wipe the lip of the bowl clean to ensure the top section can fully connect to it.
- Wet the inside of the top section of the meter and attach the top section to the measuring bowl. Secure the top section with the watertight clamp.
- Add 1 pint of water by inserting the funnel into the top of the assembled air meter. Then add and record the amount of isopropyl alcohol used. After, add water until it appears in the graduated neck and remove the funnel. Use the syringe to add water until the bottom of the meniscus is level with the zero mark on the graduated neck. Next, attach the watertight cap.
- Invert the air meter and shake for 5 seconds before returning the meter to its upright position. The inversion and shaking process must be repeated for at least 45 seconds.

- The air meter is then tilted 45 degrees and rolled 1/2 turn several times before turning the meter 1/3 turn and repeating the process for 1 minute. If any liquid is leaking from the meter, the test is invalid and a new test must be started.
- After rolling, set the meter upright and loosen the cap to let the pressure stabilize. The liquid is stabilized when it does not change more than 0.25% in a 2-minute period. If it takes more than 6 minutes to stabilize or there is more foam than 2% on the scale, the test must be discarded and restarted with a larger amount of alcohol.
- Record the liquid level from the bottom of the meniscus to the nearest 0.25%. If the air content is greater than 9% and cannot be read, add enough calibrated cups of water to bring the liquid level back to the graduated neck. Record the number of calibrated cups used.
- Retighten the cap and repeat the rolling process for 1 minute and record the liquid level once it stabilizes.
- If the second reading is within 0.25% of the initial reading, record it as the final meter reading. Otherwise, record the second reading as a new initial reading and repeat the rolling process for a third time. If the reading is within 0.25% of the new initial reading, then record it as the final meter reading.

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Understanding how to prepare an accurate, representative concrete sample is important for use in a compressive strength test.

- If the third reading has changed by more than 0.25%, discard and restart the test using more alcohol.
- Finally, disassemble the air meter and dump out the measuring bowl. The aggregate should fall out and be washed clean of any paste. If there are any portions of undisturbed concrete, the test is invalid.

MAKING AND CURING CONCRETE TEST SPECIMENS

Strength is the foundation of most concrete mixes and is why we see buildings constructed 2,000 years ago still standing. ASTM C39, "Standard Test Method for compressive Strength of Cylindrical Concrete Specimens," covers the proper testing procedures for compressive strength, but knowing how to prepare an accurate, representative sample is important. ASTM C31, "Standard Test Practice for Making and Curing Concrete Test Specimens in the Field," provides the guidelines for molding cylinder and beam specimens for use in a compressive strength test. While beam specimens can be created, this article covers the creation of cylinders.

The equipment required to create a cylinder specimen include:

- Cylinder molds that adhere to ASTM C470, "Standard Specification for Molds for Forming Concrete Test Cylinders Vertically." The cylinders can be 4 by 8 inches or 6 by 12 inches.
- A tamping rod of the appropriate diameter in accordance with C31, depending on cylinder size.
- A 1.25-pound rubber mallet for tapping the sides of the mold.
- A scoop for filling the mold.
- A trowel or other finishing tool.

The steps to create a sample include:

- Write information identifying the sample on the mold. Make sure the information is readable and will not be obscured later. Do not mark on the caps of the mold because caps can be easily removed and misplaced.
- Fill the molds in the appropriate number of layers. A 4-by-8-inch mold must be filled in two layers of equal volume. A 6-by-12-inch mold must be filled in three layers of equal volume. Rod each layer 25 times and tap the outside of the mold 10-to-15 times with the mallet.
- If the concrete falls beneath the mold at any point during consolidating the top layer, stop and fill with the excess concrete.
- Strike off the top surface using the tamping rod, trowel or handheld float.
- Immediately move the specimen to a curing place for storage.

BE VIGILANT

Letting a mix through that has failed a test can have disastrous results. A QC technician's goal isn't to pass every concrete mix, but to be vigilant about mixes that don't pass. If something is not able to pass a test, it is important to alert your supervisor immediately. After all, wouldn't you want to know if your doctor found something during a check-up? **PI**

Mitch Rector is a technical services engineer with NPCA.

Concrete REPAIR

By Eric Carleton, P.E.

Editor's Note: *This article provides information about repairing precast concrete drainage and buried infrastructure products. Though some information pertains to architectural and prestress products, these products' unique aesthetic and structural properties are beyond the scope of this article. For additional information, please review the Precast Concrete Architectural Repair Guide found on precast.org or read PCI's Manual for the Evaluation and Repair of Precast Prestressed Concrete Bridge Products and the NCHRP Report 654, "Evaluation and Repair Procedures for Precast/Prestressed Concrete Girders with Longitudinal Cracking in the Web."*

Precast concrete producers strive to cast the perfect product every time. However, even with highly trained employees and controlled production conditions in a precast plant, some cast structures may not exhibit the perfection anticipated when stripped from the form. Minor surface imperfections could include honeycombing, a small void in a corner or slight slumping of the concrete near a joint header. In those situations, durable concrete repair is necessary before the product is sent to the job site.

Most concrete repair literature from the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers and American Concrete Institute is directed toward installed concrete structures that have experienced a problem due to environmental factors, corrosion or extreme service conditions. However, the processes and procedures described can also be applied as best practices for precast concrete repair.

STEP 1: EVALUATE THE PRODUCT

The first step is to carefully review the product needing repair and determine the cause and extent of the damage. Graham Bettis, P.E., of Texas Department of Transportation Bridge Division's construction and maintenance branch, described it during a webinar presentation as evaluating the damage and diagnosing the problem. He further broke down the evaluation and cause as three components: defect, damage and deterioration.

It is important for the repair crew to understand the specific issue to be corrected to ensure the correct repair process and products are used. Additionally, this information is vital for management to know for making necessary corrections to eliminate future repairs, whether that is updating production practices, repairing or replacing formwork, material movement or handling practices and/or stored materials inspection.

The first evaluation is to determine whether the product should be repaired. Most ASTM standards address this issue. Therefore, an important part of the evaluation is


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not simply can it be repaired, but can it be repaired to meet the specification's finished product requirements. In some cases, this includes the approval of the owner. This may not be a concern if the repair is a small honeycombed area along the vertical surface of a buried inlet box, but may be of concern if the repair is a broken spigot for a gasketed joint system requiring tight or low-degree of tolerance.

To assist field inspectors on department of transportation projects for this varying subject of acceptability of repaired precast drainage products, an AASHTO task group of engineers, construction groups and industry representatives published R73-16, "Standard Practice for Evaluation of Precast Concrete Drainage Products." This document can provide guidance for evaluating repairs.

Categorize and classify

When consensus supports the precast section should be repaired, the analysis then focuses on classifying the type of repair as structural, performance or cosmetic.

Defects

A large majority of precast concrete repair is to correct a defect. Typically, product defects are caused during the manufacturing process. These issues characteristically show up as non-structural surface anomalies such as honeycombing, bugholes, small voids or shrinkage cracks. In addition, some production defects could be a minor corner spalling or small surface slump cracks, which can occur during stripping and moving dry-cast products prior to a hardened set. These defects are often first observed early in the form-removal process while the concrete is still plastic in the case of dry-cast concrete, or within 24 hours of initial set in the case of wet cast or self-consolidating concrete products. This can provide advantageous cementitious repair options to be discussed later.

Many of these surface and minor spalling defects are not structural in nature and in most cases require cosmetic repair. However, depending on the depth of the surface defect and placement of the reinforcement, these issues may also be performance related and potentially could reduce the steel's durability and structure's service life. Even buried drainage products that are out of sight may have special aesthetic applications, such as a precast box culvert placed for a pedestrian underpass, a wet well or lift station with the top 2 feet exposed for worker access or a projecting culvert-flared end section. When determining if a cosmetic repair is necessary, consider these two items:

1. Even if the precast concrete product is buried, a precast product's appearance can be your best salesman or your worst.
2. A precaster's reputation by the receiving contractor and inspector can be improved by the product's appearance.

Some production defects would fall under the structural classification. Examples are an incorrect form setup or a form core shift that modifies a product wall thickness beyond accepted tolerance or steel placement without adequate cover. Even if these defects may have viable repair remedies, this type of defect would typically require the approval of the owner or jurisdiction having authority.

Damage

Damage to precast products is typically due to handling the hardened concrete in the plant, or in the yard when storing for inventory or shipment. This type of damage is often characterized by spalling. Depending on the spall size and placement, the repair classification could be cosmetic, performance or structural. However, it is also important for the repair evaluation group to carefully inspect damaged sections for cracking. If impact cracks are found, further analysis will be needed to determine if the crack is reparable and the structure is sound.

Deterioration

Since we are talking about plant repair of precast concrete products, deterioration evaluation would not typically be considered part of the process. However, there could be a situation when a long-inventoried product is pulled from storage and used on a project. The storage may have initiated some deterioration, which will require repair before it would be in compliance with the intended standard. Though not specifically a precast concrete issue, other attached products could have been damaged, corroded or faded, such as ultraviolet-resilient rubber boot connectors or polymer steps, steel lift inserts or product identification markings. Concrete deterioration – if more than surface deep – can require extensive removal and


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A plant's repair crew should receive adequate training on the proper repair processes and materials.

rework, which could prove more expensive than simply manufacturing a new product.

STEP 2: CHOOSING PROPER REPAIR METHODS

The next step is to choose the proper method and product for the repair. This task might seem overwhelming based on the numerous repair products and options currently available on the market. However, keeping simplicity and timing in mind can help with your decision.

The Bureau of Reclamation's Guide to Concrete Repair, Second Edition, states, "Whenever possible, repairs made on new or old concrete should be made as soon as possible after the need for repair is realized. Especially for new concrete work, repairs that will develop the best bond and are most likely to be durable and permanent are repairs that are made immediately after stripping forms, while the concrete is still green. For this reason, repairs to newly constructed concrete should be completed within 24 hours after the forms have been removed and no more than 72 hours after the concrete is placed."

Sometimes what we make is not perfect.

Fortunately for precast concrete, many of those imperfections can be **corrected** with well-planned and executed concrete repair best practices.

Newly cast concrete often provides an ideal surface on which to affix the repair mix. It is uncontaminated by dirt, dust and other debris. The repair area also still has a damp, likely surface-saturated dry, active cementitious surface ready to receive the repair mix. For these conditions, it is not only beneficial but economical to use the same or similar concrete mix that was used to cast the original structure. Depending on the size or depth of the repair, coarse aggregate may be added. If coarse aggregate will hinder the placement of the repair concrete, it can be removed by sieving. If that is impracticable, a cement mortar can be made using the plant cement mixed with fine aggregate and clean water. Cement mortar mix use should be accomplished by trial batches to evaluate and optimize curing properties, such as shrinkage and color match.

Upon completion of the concrete repair, the newly placed concrete needs to cure in accordance with good practices. Should normal production procedure dictate that the hardened product be taken to the yard, accommodations need to be made to keep those repaired sections within the curing area until the repaired concrete has set and bonded with the precast section. It should be noted the repaired area is still fragile and will require special treatment to keep it away from thermal shock or direct sunlight. It should also be kept in a moist atmosphere.

If the repaired concrete is to be placed on hardened concrete from a section that has been in the yard or job site, then using a bag-repair mix might be the best option. Bagged mixes are available as cementitious, cementitious with polymer additives, cementitious with epoxy additives or simply epoxy material. The large variety of bag-repair mixes available can also make choosing the right product for the repair confusing. One method to pare down the list of available products is to determine if the municipality, DOT or contractor has developed a list of preapproved materials. In addition, the dimensions of the repair and application of the repaired product help dictate the type of repair material to use.

Generally, cementitious materials work well for most repairs on precast products. If the repair is thin – less than 1/2 inch – then a polymer or epoxy mix may be the best option. However, it is important to understand the correct application procedures when using concrete mixes with polymers or epoxy-type repair materials. Often the surface prep is not surface-saturated dry like typical cementitious mixes, but perfectly clean and dry. In addition, a special bonding agent needs to be applied prior to placing the repair material. The number one reason specialty repair bag mixes fail is a failure by the technician to follow the proper mixing and curing directions.

When reviewing the repair mix options, consult with a trusted professional for recommendations. When comparing product data, verify they have been tested to the protocols outlined within American Concrete Institute 364.3R, "Guide for Cementitious Repair Material Data Sheet," or the International Concrete Repair Institute 320.3R, "Guideline for Inorganic Repair Material Data Sheet Protocol."

An important factor when choosing the correct repair material is to ensure there is compatibility between the original precast concrete and the repair material. Many incorrectly believe a stronger bag mix means a faster cure and better repair. However, unless those specific attributes are required, the opposite is often the better solution. The best repair product is one with mechanical properties that closely match the original concrete. Therefore, if the precast product has compressive strength required to exceed 4,000 psi and the actual testing shows strength of 5,000-to-6,000 psi, the repair material needs to exceed 4,000 psi to ensure

The finished repair should be inspected and verified by the quality control technician to ensure all work was done successfully.

compliance. ACI 546R-14, "Guide to Concrete Repair," states the problem of product compatibility in regard to mechanical attributes in strong mixes – such as modulus of elasticity, permeability and thermal expansion – may not be in harmony with the original concrete base. This may lead to premature delamination of the repaired section when the product is put into service. Unless repair and shipping constraints require a rapid curing product, a slower setting – along with extended curing time for the repaired product – will provide the best results. When evaluation and product comparisons have been completed, it is time to choose the correct product and repair procedure.

STEP 3: WRITE IT DOWN

The third step is to prepare and develop repair procedure documents for design and construction. Because these repairs are to be accomplished at the plant, some precasters may think it's OK to skip this process and go directly to the repair activity. However, it's a best practice to have a specific and detailed written procedure developed for each company or plant's specific type of repair. This means separate procedures need to be included if the repair is a surface defect, a spall, slab off, crack, lift insert, replaced manhole step or any other unique repair.

DOCUMENT ITEMS TO INCLUDE CAN BE:

- The minimum training and qualifications of the personnel doing the repair work
- A list of repair products
- Mixing requirements
- Descriptions of surface preparations
- Material applications procedure
- Curing requirements
- Quality control inspection and approval process

The development and application of this document will provide better assurance of repair uniformity, quality, function and durability. This is the primary reason it is a required element of Section 4.7 of the NPCA Quality Control Manual for Precast Concrete Plants. A well-written repair procedure document ensures that repair best practices and lessons learned are shared with everyone. It also serves as a historical record when implementing small but continuous improvements to repair processes and products used.

The International Concrete Repair Institute, in conjunction with ACI Committee E706 Concrete Repair Education, developed a detailed repair procedure document series called, "Repair Application Procedure." This can be used for reference or as a template when writing your document. Similarly, many DOTs have developed detailed repair procedures that can be implemented into a plant-specific document. In addition, technical information can be provided by the repair mix manufacturer.

Most owners or contractors that receive a precast product that needed a repair want to know it was accomplished correctly, professionally and that it will have no effect on the product's function or service life. Those owners and contractors may request a repair procedure document and a thorough, complete document will ensure the greatest success for acceptance.

STEP 4: COMPLETE THE REPAIR

The final step is to perform the repair work and implement the action plan and repair procedures developed within the third step. A critical action is to ensure the repair crew has been adequately trained on the materials and processes. A concrete repair craftsman is often as much an artist as a technician. It takes a special skill set, pride in the work and patience to repair concrete structures to new condition. However, even the best repair employee who has only worked with plant mix mortar repair will need training if the next repair requires the use of a bag-mixed material or one with a polymer additive. That training should also include appropriate safety information and familiarity with the product's material safety data sheet. Some companies provide a special repair training program and issue certificates to newly qualified employees who have successfully completed training. Only those plant-qualified employees can do product repairs.

Upon completion of the repair, it is important for the work to be inspected by another party other than the repair crew. This is typically done by the plant's QC technician who can use a variety of simple tests – in addition to visual inspection – to verify a solid repair has been accomplished correctly. An excellent practice found in the NPCA QC Manual states, "After repairs are completed and inspected, a mark shall be made on the product indicating that it is acceptable, or that it is rejected."

This practice not only provides accountability to the repair, but offers some added insurance to the contractor and owner of the precast product that the repair was done well.

As humans, we are not perfect. Consequently, sometimes what we make is not perfect. Fortunately for precast concrete, many of those imperfections can be corrected with well-planned and executed concrete repair best practices. **PI**

Eric Carleton, P.E., is NPCA's director of codes and standards.

RESOURCES:

ACI 364.13T-15, "Repairs for Reinforcement with Shallow Cover," www.concrete.org/store/productdetail.aspx?ItemID=36413T15&Format=DOWNLOAD&Language=English

ACI 364.3R, "Guide for Cementitious Repair Material Data Sheet,"

www.concrete.org/store/productdetail.aspx?ItemID=364309&Format=DOWNLOAD&Language=English

ACI 546R-14, "Guide to Concrete Repair," www.concrete.org/store/productdetail.aspx?ItemID=54614&Language=English

ACI 546.3R-14, "Guide to Materials Selection for Concrete Repair,"

www.concrete.org/store/productdetail.aspx?ItemID=546314&Language=English

AASHTO R73-16, "Standard Practice for Evaluation of Precast Concrete Drainage Product,"

bookstore.transportation.org/item_details.aspx?ID=2629

ICRI 320.3R, "Guideline for Inorganic Repair Material Data Sheet Protocol," icri.org/?page=free_publications

ICRI RAP-10, "Leveling and Reprofiling of Vertical and Overhead Surfaces,"

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NPCA Quality Control Manual for Precast Concrete Plants, 12th EDITION

TXDOT Concrete Repair Manual, January 2017

onlinemanuals.txdot.gov/txdotmanuals/crm/crm.pdf

Webinar, TXDOT Proper Design and Implementation of Concrete Repairs. Graham Bettis, P.E.

U.S. Army Corps Engineers, "Evaluation and Repair of Concrete Structures," 1995,

publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-2002.pdf

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usbr.gov/tsc/techreferences/mands/mands-pdfs/Guide2ConcreteRepair2015_Final.pdf

Concrete Mix Design: WATER

By Paul Ramsburg

Editor's Note: *This is the first article in a year-long series that explores the science of concrete to provide a better understanding of mix design. The series will be collaboratively written by Paul Ramsburg, technical sales specialist at Sika Corp., and Frank Bowen, quality control manager at Piedmont Precast.*

A foundational part of what we do in the precast industry is design concrete mixes that meet the desired engineered properties of the products we manufacture. Product strength, durability, aesthetics, workability and cost-effectiveness are all considerations we must take into account during the process. Given this, there is a need in the industry for better understanding about precast concrete mix design by everyone, no matter what their role is in the company. Frank Bowen from Piedmont Precast and I hope to encourage new interest in the science of concrete, as well as offer some reminders to industry veterans who have worked around the batch plant for decades. In this year-long series, we will cover what we feel everyone in the industry should know about concrete mix design.

WATER AS A MIX CONSTITUENT

Water is a basic building block for concrete. If you are thinking of water as an inert material that is just

NPCA-certified plants are required to ensure that water used in mix designs meets specification requirements.

NPCA file photo

sprayed into the mix until a slump forms, then you are thinking about it all wrong. Water is a critical material which must be dosed accurately in order to gain a desired outcome after undergoing a chemical reaction with the cement and other mix constituents.

As a rule of thumb, any potable water is acceptable for use in concrete. That does not entirely exclude "gray water," known as process water, nor does it mean that all potable water meets specifications on limits of solids and compounds. NPCA-certified plants are required to ensure that the water used meets the criteria set out in relevant specifications. Impurities in water can interfere with the setting of cement and can adversely affect concrete's strength and durability. Many possible constituents present in water may actively participate in the chemical reactions and affect concrete's set time and strength development. Limits are specified for mix water with constituents such as total alkalis and chloride sulfate. It's important to understand what is in your water and how it affects your mix in particular.

RECYCLED WATER

Many production facilities are limiting their use of fresh water in batching concrete. This may be due to a limited supply of fresh water in their area, an effort to limit waste-process water or the decision to be responsible consumers. Whatever the reason, it is possible to successfully batch quality concrete with recycled water that has been reclaimed from production processes. Testing should be done on concrete using recycled water at various percentages of total batch water to ensure it doesn't negatively affect set time, strength and durability.

WATER-CEMENT RATIO EXAMPLE

33 gallons of water x 8.34 pounds/gallon = 275 pounds of water
538 pounds of cement + 120 pounds of fly ash = 658 pounds
275/658 = 0.42

WATER-CEMENT RATIO

Approximately 100 years ago, American Concrete Institute's first president Duff Abrams first published his concept on the effects of water-cement ratio on concrete's strength and durability. Now, when I say w/c ratio, I mean water-cementitious material ratio. This means when you calculate w/c ratio include all cementitious and pozzolanic powders. It's been known for 100 years that w/c ratio is the biggest factor on both 1-day and 28-day strength. You can increase compressive strength and reduce segregation in self-consolidating concrete mixes by lowering the w/c ratio. In addition, w/c ratio is easy to calculate. The equation is in the name: you simply divide the weight of water by the total weight of cementitious material. What ratio you target depends on what you want from the mix. Typically, high strength mixes (6,000-to-10,000 psi) have a low w/c ratio such as 0.38 and lower strength mixes (5,000 psi) may have a ratio of up to 0.45. Low w/c ratio mixes are denser, and therefore exhibit greater durability than high ratio mixes.

Concrete mixes with lower water content will need to have a higher water-reducing admixture added to achieve high slump or flowability. These mixes are typically described as sticky. The end product may be more difficult to finish, but it is often good for SCC mixes. These mixes are more resistant to segregation and excessive bleed water because they have a high viscosity.

DON'T FORGET ABOUT AGGREGATE

Another source of water is introduced in concrete through aggregate. When you batch aggregate, it contains some amount of moisture, usually about 1% from stone and 3-to-7% from sand. This must be accounted for in the w/c ratio calculation. If this concept is new to you, there are several resources available on the subject on precast.org. It also bears mentioning that until you get trustworthy results from moisture probes, they must be calibrated on a regular basis. NPCA certified plants are required to validate probe calibration with aggregate moisture testing a minimum of once per week.

LOOKING FORWARD TO THE YEAR AHEAD

As we discuss precast concrete mix design over this series of articles, I hope many of you will be inspired to learn more, to experiment and to get your hands dirty. In the next article, we will learn more about aggregate, but for now remember when it comes to water there is a great need for accuracy. Water is not just water, it's an important mix constituent. **PI**

Paul Ramsburg has worked in the prestressed concrete industry since 1988 and is currently a technical sales specialist at Sika Corp.

Taking SEPTIC TANKS to the Next Level

Advanced Treatment

By Claude Goguen, P.E., LEED AP

Editor's Note: *This is part two of a three-part series that is intended to educate wastewater structure manufacturers about the nature of septic tank influent, what happens to wastewater in a typical tank and what else can be done to increase that level of treatment. The series also offers suggestions on ways to increase the level of serviceability by offering different types of systems and treatment options for a wider range of needs.*

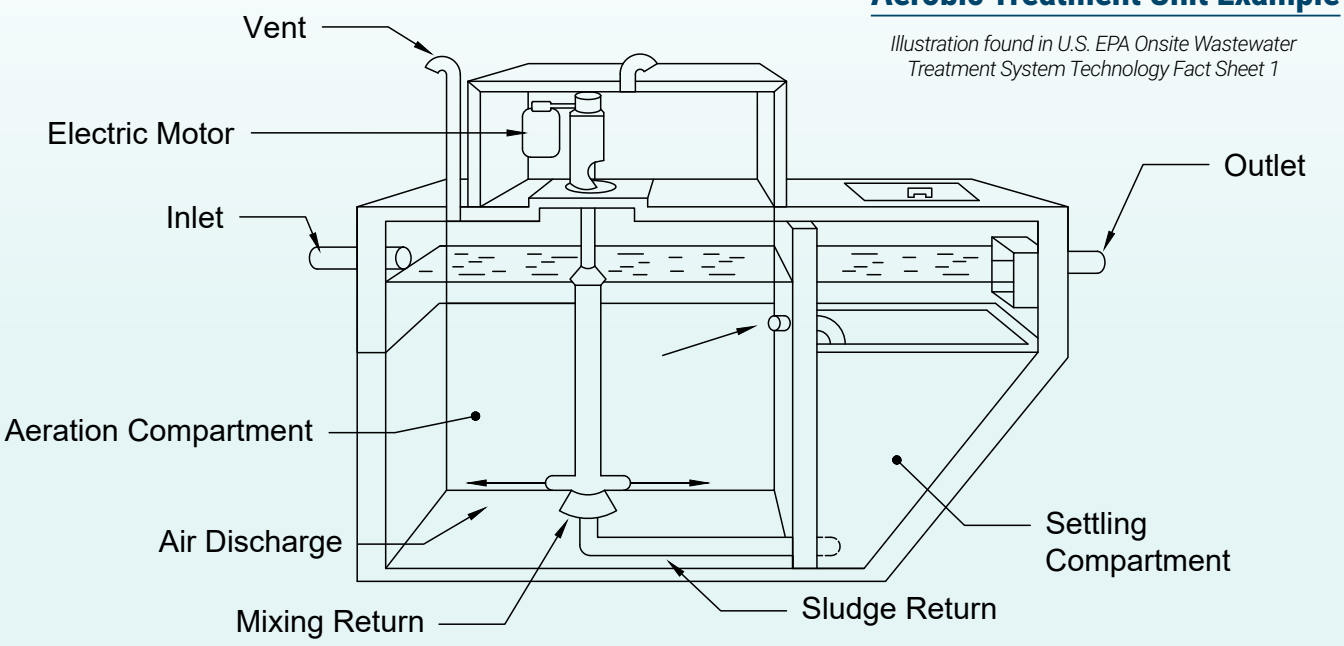
Many purchases we make – such as a car, refrigerator or cell phone – force us into a decision dilemma. Do I need seat warmers? How about a "smart" refrigerator or facial recognition for my phone? Septic tanks come with options as well. However, these options can be necessary or even required depending on the region and proximity to sensitive areas. The options may enable additional treatment to increase the performance of the septic tank.

ADVANCED TREATMENT

At times, the nature of the wastewater, the sensitivity of the receiving environment, or the unsuitability of the soil or site may require more than just a septic tank and soil treatment system. Your client may need a secondary or advanced treatment system. These systems can treat household waste to substantially lower biological oxygen demand (BOD), total suspended solids (TSS) and reduce specific nutrients or pathogens prior to moving on to the soil treatment system. It's important to be prepared for these situations, especially if you service an area that traditionally requires secondary or advanced treatment. The examples that follow are a few of the many advanced treatment technologies that exist. These specially designed systems incorporate additional phases to create conditions that facilitate enhanced treatment.

Aerobic Treatment Unit Example

Illustration found in U.S. EPA Onsite Wastewater Treatment System Technology Fact Sheet 1



The main types of advanced treatment systems are:

- Aerobic treatment units or advanced treatment units (ATU)
- Media filters

Aerobic treatment units

A common type of advanced treatment involves the use of oxygen. ATUs add air to break down organic matter and reduce pathogens and nutrient loading. Conventional septic tank treatment is anaerobic, which means it is done in the absence of oxygen. ATUs use oxygen to foster the growth of bacteria that thrive in oxygen-rich environments. These bacteria break down and digest the wastewater inside the ATU as they are suspended in the liquid. Compared with conventional septic tanks, ATUs break down organic matter more efficiently, achieve quicker decomposition of organic solids and reduce the concentration of pathogens in wastewater. There are many types of ATUs available, and with that comes a variety of efficiencies. According to the University of Minnesota's Onsite Sewage Treatment Program, a properly operating ATU should produce high-quality effluent with less than 30 milligrams per liter BOD, less than 25 milligrams per liter TSS and less than 10,000 colony-forming units per 100 milliliters of fecal coliform bacteria – an indicator of pathogens and viruses.

Courtesy of University of Minnesota

Aeration in an ATU breaks down organic matter.

Media filters

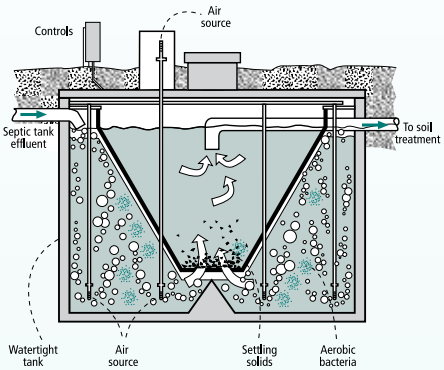
Various media can be used to filter wastewater before sending it to the soil treatment system. Sand is commonly used as a filter media. Effluent from the septic tank flows into a pump tank and is evenly applied over the sand surface. A timer is used to dose the entire surface of the filter intermittently. This draws oxygen from the atmosphere through

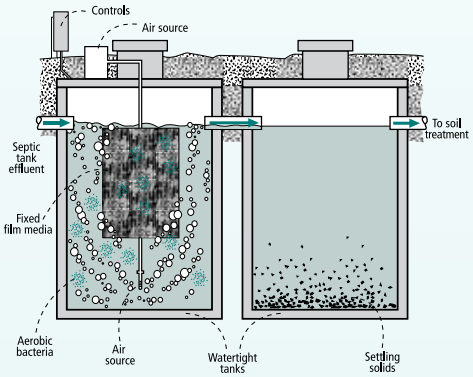
What to Know

When Choosing an Aerobic Treatment Unit

There are three basic aerobic treatment unit operation styles: suspended growth, fixed-film reactor and sequencing batch reactor. All three types usually have a septic tank ahead of them that separates large solids.

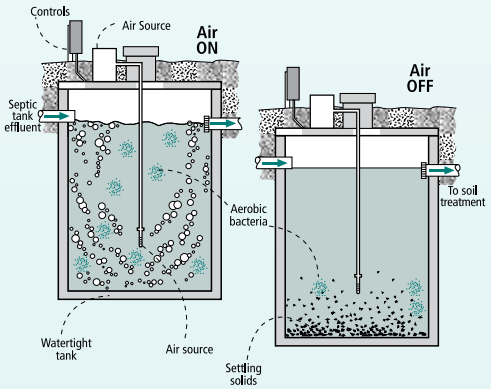
Suspended-growth systems include a main compartment called an aeration chamber in which air is mixed with the wastewater. Because most home aerobic units are buried underground, the air must be forced into the aeration chamber by an air blower or a compressor. These systems do not provide media for attachment of bacterial film but rely on bacteria suspended in the wastewater. A second compartment is used for settlement of solids. The two compartments are connected, so settled bacteria from the settlement chamber can be brought back into the treatment chamber.





Fixed-film systems use a porous surface, which provides a medium to support the biomass film that digests the waste material in the wastewater. Designs for fixed-film systems vary widely, but fall into two basic categories. The first is a system where the media is moved relative to the wastewater, alternately immersing the film and exposing it to air. The second system uses a stationary media and varies the wastewater flow, so the film is alternately submerged and exposed to air. In both cases, the biomass must be exposed to both wastewater and air for aerobic digestion to occur. The film itself may be made of any suitable porous material such as formed plastic, fabric, styrofoam or gravel. This would also have a second settlement chamber.

Sequencing batch reactors contain the aerobic decomposition, settling and return phases in the same chamber. Air is bubbled through the wastewater during the decomposition cycle. The bubbler then shuts off and the wastewater goes through a settling cycle. Once the bubbler turns back on, the tank re-enters the decomposition cycle and the settled bacteria mixes back into the aerobic environment. Next, the treated effluent is discharged to the soil treatment system. These systems are not widely used but can save space.



Graphics courtesy of University of Minnesota

the sand medium and its attached microbial community. The effluent is treated by physical, chemical and biological processes within the media. Suspended solids are removed by mechanical straining due to enhanced contact and sedimentation. Treatment occurs through the bacteria that colonize in the sand grains. Microorganisms use the organic matter and nutrients in the effluent for growth and reproduction. A properly operating sand filter should produce high-quality effluent with less than 10 milligrams per liter BOD, less than 10 milligrams per liter TSS, and less than 200 colony-forming units per 100 milliliters of fecal coliform bacteria.

Peat is also used as a filter material. The clarified effluent from the septic tank is added by gravity or by pump to the peat filter. The peat acts like a sponge by absorbing and wicking the wastewater and providing treatment as it filters. Peat is partially decomposed organic material with a high-water capacity, large surface area and chemical properties that make it effective in treating wastewater.

In research conducted in Minnesota, peat filters removed high concentrations of nutrients (nitrogen and phosphorus) and produced a high-quality effluent with less than 30 milligrams per liter BOD, less than 25 milligrams per liter TSS, and less than 1,000 colony-forming units per 100 milliliters of fecal coliform bacteria.

A recirculating media filter (RMF) pretreats septic tank effluent by filtering it through a medium of coarse sand gravel, peat or textile before sending it to the soil treatment system. A recirculation system has an advantage in areas where nitrogen contamination is a problem. As wastewater moves through the filter and becomes oxygenated, ammonia is transformed into nitrate. In the recirculation tank, conditions are anoxic (low in dissolved oxygen) and bacteria breaks down nitrates and releases nitrogen back to the atmosphere – a process called denitrification. Because of the large media size, RMFs do not remove fecal coliform as effectively as single-pass sand and peat filters. Liquid effluent moves by gravity to the recirculation tank. Here, effluent that has been recirculated through the filter is mixed with septic tank effluent. Effluent is pumped repeatedly through a lined filter and then back – by gravity or pump – to the recirculation tank. In the filter, biological treatment occurs as the effluent passes the surfaces of the filter media. Treated effluent is collected at the bottom and returned to the recirculating tank where the cycle begins again. After the effluent has gone through the filter several times, a controlling mechanism sends the effluent to the soil for final treatment.

Other materials such as foam, textile, crushed glass and coconut husks are used for filtering media. Some systems let the wastewater filter through the media while others let the effluent trickle over a bed of porous material.

Nitrogen removal

Treatment systems for nitrogen removal are generally done through a sequential process that mimics the natural nitrification/denitrification process using engineered systems. The first step in the sequence uses aerobic processes to transform the organic nitrogen and ammonia products in the septic tank effluent to nitrates and nitrites, which is the nitrification step. A variety of treatment devices can be used to accomplish this aerobic process, such as sand, gravel filters or ATUs.

The second step requires shifting the process from an aerobic to an anaerobic environment. The nitrates and nitrites need to be in an environment without oxygen and with a carbon source, so the oxygen molecules can be stripped off leaving harmless nitrogen gas into the environment. 78% of the air we breathe is nitrogen gas.

There are a variety of systems that are designed to do this, but most rely on this two-step process:

1. **Aerobic and anaerobic phases**
2. **Introduction of a carbon source during the denitrification step.** This is done either by recirculating the nitrified wastewater back through the septic tank – which has high organic carbon content – or by adding an external carbon source to the denitrification unit.

Pathogen reduction

The most common method for final treatment used in on-site systems to remove harmful pathogens is ultraviolet radiation. The germicidal properties of UV irradiation have been recognized for many years. The radiation penetrates the cell wall of the organism and is absorbed by cellular materials, which either prevents replication or causes the death of the cell. The water must be relatively free of turbidity for UV radiation to effectively reach and destroy the organism. Because UV light has a limited distance to be effective, the most disinfection occurs when a thin film of water is exposed for treatment.

Before rushing out to acquire these advanced treatment systems, it's important to know which systems are approved in your area.

Every state should have a list of approved technologies, so that's the best place to start.

WHICH SYSTEMS CAN BE USED WHERE?

Before rushing out to acquire these advanced treatment systems, it's important to know which systems are approved in your area. Every state should have a list of approved technologies, so that's the best place to start. Consider contacting vendors on that list to receive more information on these systems and how compatible they are for your specific products.

EDUCATE YOURSELF

The technology in advanced treatment is moving very quickly and there are many systems that may not be represented in this article. Many NPCA members manufacture and/or sell the systems and can be consulted further on how they may be an asset to your business. The key is to educate yourself on these systems so you can properly explain them to homeowners. Each system comes with maintenance requirements that must be clearly explained to users. Many precasters have developed additional income from the maintenance and service associated with advanced treatment systems. **PI**

Claude Goguen, P.E., LEED AP, is NPCA's director of sustainability and technical education.

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A FAMILY *Affair*

Exploring the **highs and lows** of working in a family-run business

By Bridget McCrea

Running a family business isn't always easy, particularly when there are multiple generations of leadership and ownership at play. According to the Family Business Institute, 88% of current family business owners believe their families will control the business in five years, yet actual succession statistics undermine this belief. Just 30% of family businesses survive into the second generation, 12% are still viable into the third generation, and only about 3% of all family businesses operate into the fourth generation or beyond.[1]

In the precast concrete industry, many companies have bucked this trend and are now being led by the third, fourth or even fifth generation. Pink Precast proudly falls into this category. Founded in the height of the depression by Christopher John Pink, the 86-year-old company is currently in the capable hands of the fourth generation, brothers Wade and Dan Pink.

Based in London, Ontario, and with a U.S. office in Kimball, Mich., Pink Precast grew slowly over time, adding new product lines like septic tanks and agricultural precast products along the way. Wade and Dan took over ownership in 2009 – right in the throes of another national recession – and one of their first tasks was to change some of the strategies that the company had been operating on for decades. An early change was the use of vacation days.

(Left to Right) Brothers Tim Goode, sales and marketing manager, Taylor Goode, marketing manager, and Rick Goode, CEO, of Columbia Machine in Vancouver, Wash.

"The old school mentality was that you took vacation when you had the time for it, but the new generation of employees doesn't play by those rules," Wade said. "We realized that our employees could use a little more time off, so we instituted some flexible policies around vacation time."

In a similar vein, the company began allowing some of its employees to work shifts such as 7 a.m. to 3 p.m., or 9 a.m. to 6 p.m., rather than a standard 8 a.m. to 5 p.m. shift. The goal is to help accommodate employees' family and personal lives.

Another change involved the recognition of long-term employees on milestones like 10-year and 20-year work anniversaries.

"We recently had someone celebrate his 40th year with (the company)," said Wade, who adds that the recognition and flex time have both gone over well with employees.

As with any closely held business, there are both highs and lows of working with loved ones. On the positive side, Wade said the firm oozes "family feel," and treats all employees as kinfolk. In fact, he said the company has spawned a second group of relatives that aren't directly related to the Pinks. To cultivate that family-like unit, the company holds barbecues, annual golf tournaments and other events for its staff, many of whom are long-term employees.

"There are people working here whom I've known for my entire life," Wade said.

When it comes to challenges, Pink said it can be a tough pill to swallow for family members – or for the 30-year employee who has worked there since he was 18 – when a new person is suddenly your boss.

"Having those difficult conversations can be harder than usual, particularly if you have to have those talks with someone you've known all your life," Wade said.

THE NEXT 80 YEARS

Columbia Machine was founded in 1937 and is currently a third-generation family business. Rick Goode serves as CEO of the Vancouver, Wash.-based company, Tim Goode is sales and marketing manager and Taylor Goode handles the firm's marketing efforts. The three are brothers.

According to Tim, one of the high points of working for a family-owned business is the great sense of pride of ownership associated with the experience. Incentivized to help make the business as successful as possible, family members pour much of their time and energy into the effort, knowing that it's much more than just another job.

"You're definitely invested in everything, from the small decisions all the way up to the big ones," Tim said. "That definitely plays a key part in how driven you are and how motivated you are to ensure success – and whether it's minor product development or the acquisition of another company."

Although the company has been in existence for 80 years, the Goode family is more concerned about the next 80 years and maintains its strong roots while always looking for ways to work smarter, better and faster in the future.

"It's all about forward thinking and investing heavily in the future," Tim said. "We keep a constant eye on growth and figuring out how to effectively diversify and be in the markets where the growth potential is highest."

On the flip side, Goode said running a family-owned manufacturing firm presents an interesting

Courtesy of Bethlehem Precast

Tom Engelmen, owner of Bethlehem Precast, with sons Ben (left) and Nick (right).

"When my dad passed away 10 years ago he wanted to **pass this entity on** and keep things going generationally. So, we're going to try and set this new company up so the **kids get some ownership** in it and we can pass the company down to the **next generation**."

– Tom Engelman, *Bethlehem Precast*

set of challenges. For example, the Great Recession created an especially difficult environment for the company, forcing it to cut back in various areas.

"We have plaques on our walls for employees who have been here for 45-plus years," he said. "Going through hard economic times and having to let people go – some of them being third-generation employees from the same families – was extremely difficult."

Heavily invested in taking care of its employees and customers, Columbia Machine had to balance those worker-related difficulties while maintaining its quality and customer service standards.

"We do what we can to satisfy both groups and keep everyone happy, but it's not always easy," Tim said.

Always on the lookout for new opportunities, Columbia Machine continues to invest in growth and diversification. With a strong family foundation and a mix of long- and short-term staff members to support those efforts, the company is well positioned for its next 80 years.

"We're always looking at that next established division that we can start, whether it's a small segment within the precast market, or developing a new mixer or batching controls," Tim said. "We want to be forward thinking; I think that's something that has really helped us because we're not dead set in one product line."

PASSING IT DOWN TO THE NEXT GENERATION

After working on-and-off for his family's business since the 1980s, Tom Engelman officially took over as president of Bethlehem Precast in 1995. Engelman, whose father founded the company in 1974, has five siblings (none of whom work directly for Bethlehem Precast) and a third generation of family members gradually working their way into the business.

"My two sons work here, one of whom is our full-time QC manager and the other is a business major at Penn State Lehigh Valley," said Engelman, who enjoys having a group of close relatives to fall back on when business is difficult. "When things aren't going well, they will always come in and help."

Because each of the six siblings has an equal stake in the business, juggling various opinions and requests can be challenging at times.

"There's always some sibling rivalry because I'm the oldest," said Engelman laughing. "I have to justify everything I do."

To work through that challenge, the company holds board meetings every week to review the company's status, future plans and new directions.

"Most of the time, as long as I explain myself pretty well, they understand and they usually go along with me," Engelman said. "I haven't ever really been shot down totally, but we do have our loud meetings sometimes."

This year, Engelman and his team are working to set up a new company to handle Bethlehem Precast's prestress division. The goal is to create the company and eventually transfer it to the third generation. It will be a new company with no assets and no equity, said Engelman, who likes the idea of starting with a clean slate for the next generation, which right now comprises 10 children.

"When my dad passed away 10 years ago he wanted to pass this entity on and keep things going generationally," Engelman said. "So, we're going to try and set this new company up so the kids get some ownership in it and we can pass the company down to the next generation."

Family-owned businesses often inspire passion among ownership and employees, and passion can sometimes spark conflict of differences in opinions. The businesses that survive the challenges are those with strong leadership and who are focused on precast success as well as future challenges and opportunities. They integrate family strategically and ensure everyone – family and staff – is on the same page. It's rarely easy, but when done right, the rewards far exceed the challenges. **PI**

Bridget McCrea is a freelance writer who covers manufacturing, industry and technology. She is a winner of the Florida Magazine Association's Gold Award for best trade-technical feature statewide.

RESOURCES:

1 familybusinessinstitute.com/consulting/succession-planning

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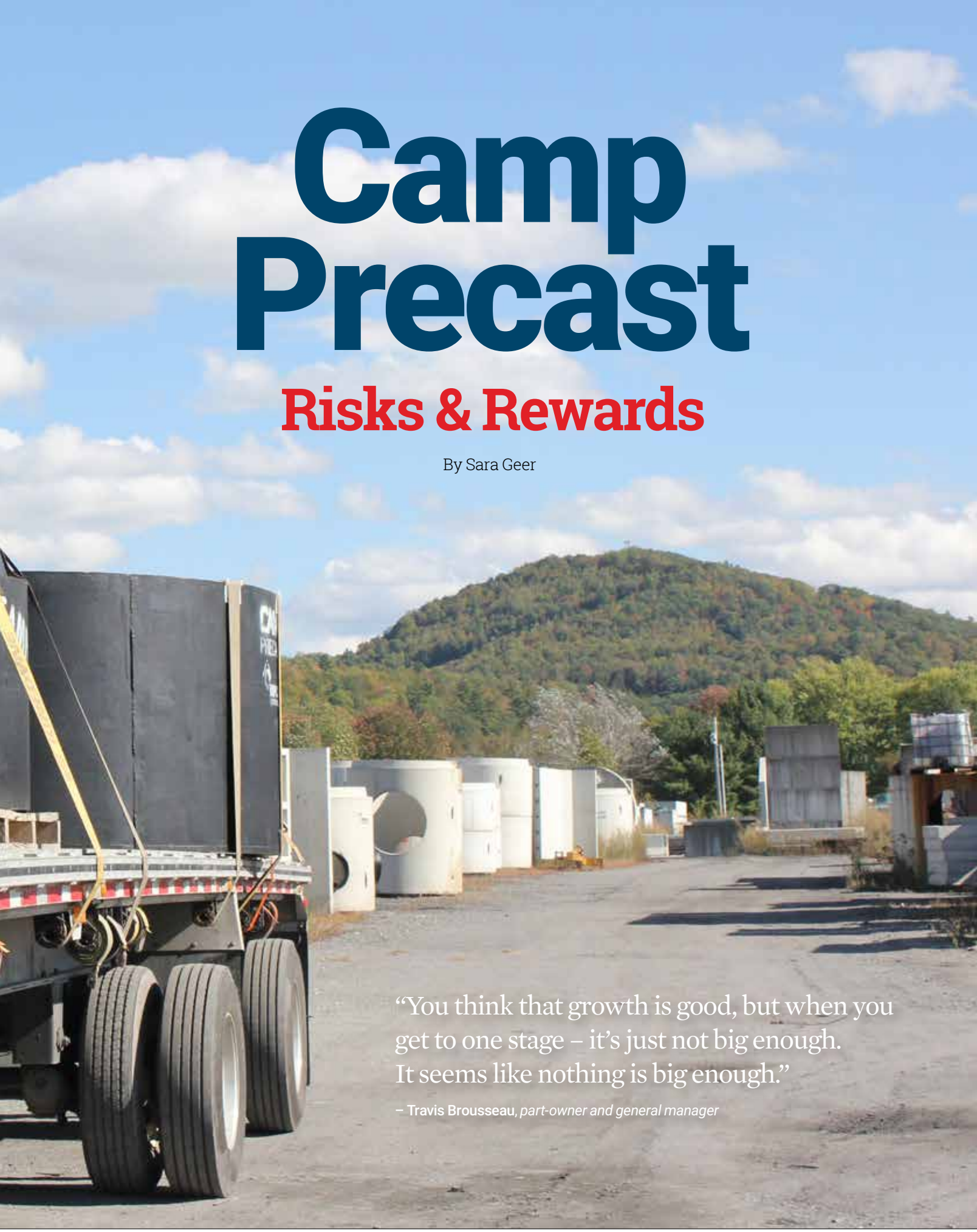
Camp Precast

Risks & Rewards

By Sara Geer



"You think that growth is good, but when you get to one stage – it's just not big enough. It seems like nothing is big enough."

– **Travis Brousseau**, *part-owner and general manager*

NPCA file photo

NPCA file photo

Camp Precast Concrete Products manufactures primarily on-site wastewater and underground utility precast concrete products. The precaster also supplies specialty items including precast concrete light pole bases.

Four generations of the Camp family (Dale Camp, founder, Kevin Camp, owner, Ethan Camp and great grandson Carlton) helped break ground on the company's new facility. Dale Camp passed in June 2017.

Courtesy of Camp Precast Concrete Products

Behaviors are either learned or hereditary. For instance, a person can learn how to manufacture precast concrete through experimentation, reading manuals, seeking advice and following the proper steps. But not all behaviors are learned. Dale Camp, founder of Camp Precast Concrete Products in Milton, Vt., had a special innate trait that many entrepreneurs and pioneers have in common. He had the gift of foresight and often saw what precast concrete products were in demand before the competition. His visionary outlook helped position Camp Precast as a leading provider of on-site wastewater and underground utility precast concrete products in the Northeast.

"In the mid '70s, Dad could see there was a market for selling pumps and controls and packaging them with our precast," said Kevin Camp, Dale's son and a second-generation owner. "He secured a distributorship with a large sewage pump manufacturer and we got into the business of supplying turnkey, packaged pump stations. Now, we build, sell and service pump stations throughout our market.

"Our service division also provides vacuum testing and field coring services. The division has grown into its own little business. We have three technicians and a manager for that division alone, and it all started with my father's vision."

Today, Kevin Camp embraces that same trait. He admits that he may not have the same skill set his father used to start the business, but he is well positioned to take it to new heights and markets never before imagined. Kevin runs the business with Travis Brousseau, part-owner and general manager.

"With Dad and I, it really was kind of a perfect marriage," Kevin said. "We complemented each other. I was able to grow the business beyond where he took it, but I don't believe I ever could have started the business and got it to where he grew it before I took over."

PAST AND FUTURE SIDE BY SIDE

In 1968, Dale and Mary Camp started Camp Precast Concrete Products at their home in Montgomery, Vt., manufacturing and selling septic tanks, drywells and distribution boxes.

NPCA file photo

The two 20-ton bridge cranes in the new facility (below) offer the company the ability to produce larger precast products indoors. The old facility (left) still stands next door.

NPCA file photo

"My dad would go out in the morning and strip the molds, set them up and then take deliveries," Kevin said. "While he was out doing deliveries and sales, my mom would go out with the ready-mix concrete and pour and vibrate tanks."

A year and half later, the company moved to its current location in Milton, Vt.

February 2017 marked the beginning of a new era for Camp Precast. Three years of extensive planning, designing and building came to fruition with the opening of a brand new, state-of-the-art facility. The plant houses the latest technologies, has the capacity for casting larger products inside a controlled environment and opens the door for more work all year long.

"It's a huge deal for the company's future," Kevin said.

For now, there is a neat side-by-side snapshot of new and old as the original building and batch plant sits next door. Kevin said the old batch plant will eventually be demolished, but for now it illustrates the company's roots and progress.

The old facility is where Kevin and his brother, Patrick Camp, took over the business in 1996 and began to expand. Together, they experienced highs in the company, such as hiring Mark Pfenning, a key employee at Camp Precast, who knows the ins and outs of the precast industry, and has extensive knowledge of the pump station and service business. Mark has been instrumental in the company's success. And they worked through some lows and transitional periods together such as when Patrick made the difficult decision to leave the family business in 2005. It was a tough time in the company's history, but also strengthened everyone for what the future holds and allowed Brousseau to take a leadership role. He has become the leader the company needs – high energy, committed in making precast his lifetime career and skilled in both the practical and engineering side of the business.

"When I first worked with Kevin and Patrick in 2004 working on CAD drawings, I would have never thought I'd still be here," Brousseau said. "Now, I'm committed for life. I like it, love it and wish I could have started even sooner."

While the company's history is tied with the original plant, the wear and tear also gives a glimpse of how production got started and where

NPCA file photo

Camp Precast Concrete Products tackled more projects for the Vermont Agency of Transportation and the New York State DOT in 2017 than in past years.

"If you don't have the capability to manufacture larger products, you'll get left behind."

– Travis Brousseau, *part-owner and general manager*

it's headed. The old plant houses one 5-ton and one 10-ton overhead crane, so any product that exceeded capacity had to be cast outside.

That's all changed now.

"When you're doing a state job, you have to do it inside," Camp said. "There are too many variables doing it outside. It can be done, but with weather restraints, it's impossible to do efficiently."

The new plant added 14,000 square feet of indoor production and a 40-ton lifting capacity when using the two new Demag 20-ton bridge cranes in unison. The company now has the capacity and equipment to tackle more department of transportation jobs and larger-sized products.

In 2017, projects for the Vermont Agency of Transportation and the New York State DOT increased significantly. The company has started working on a high-profile, state design-build railroad project with one of their customers, which requires 16 large precast sections, including precast headwalls, footers and wingwalls with grout sleeves. Culvert jobs have increased in volume and size as well. The growing trend is that products continue to get larger.

"If you don't have the capability to manufacture larger products, you'll get left behind," Brousseau said.

STREAMLINE EFFICIENCIES

One of the main reasons Kevin and Brousseau invested much of their time and energy into the plant expansion was to increase production efficiencies – with aggregate handling and wintertime production being two of the major interests.

Brousseau said before the new facility was in operation, workers loaded the aggregate bins every morning using a pay loader, which took three hours to complete. There were also times when the aggregate ran out during production and had to be reloaded, costing additional time and labor. The new aggregate bins are now placed underground, so handling goes much smoother.

"Now we're able to dump directly into the bins and not handle the aggregates twice," Brousseau said. "We can stock some aggregate if we do have to move it or load it, but most of the time, we just dump the truck when the bins are low. We save that three hours every day, which is tremendous."

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NPCA file photo

NPCA file photo

A precast concrete box culvert houses the company's underground aggregate weigh hopper.

The four precast concrete aggregate bins are 12 feet deep and have a capacity of 90 cubic yards each. The bins are built on top of a precast concrete box culvert that houses the aggregate weigh hopper. Each bin has two discharge gates that dispense the aggregates onto the weigh belt. The weigh belt transfers the aggregate to a skip hoist, which then empties it into the mixer. In order for everything to work as planned, a great deal of problem solving had to occur.

"We knew we wanted to get this set up as deep as possible so we could limit the height and length of the ramp," Kevin said. "It was a puzzle that had to take into account groundwater tables and storm drainage requirements. A lot went into this entire thought process."

In addition, the aggregates can be heated using a Polarmatic heating unit system. This was a big investment for the company.

"It would have never made sense to purchase this if we weren't building a completely new plant," Kevin said. "But when we decided to build the new plant, the decision was justified. It does three big functions for us – heats our aggregate, heats our process water and heats our plant."

The hope is the technology will allow the company to produce 80-degree concrete in the middle of winter using frozen aggregate, something the owners never thought could be possible. According to Brousseau, there were often times when the company had to purchase ready-mix concrete during the winter months because batching concrete was more expensive than buying it. And under heavy wintertime conditions, the plant would completely shut down.

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"During the winter, we usually had 12 to 14 people working in the plant and now we have 20 or more," Brousseau said. "It's quite a difference."

With the rapid growth the company has seen in the last five years, there are more permanent positions Brousseau is looking to fill.

"This year we have more work on the books because we're able to tackle more jobs with our bigger facility and our ability to pour during the wintertime," Brousseau said. "Very huge for us, yet growing pains for us too. We are still learning to streamline operations and work on the efficiencies."

NPCA CONNECTION

Kevin said much of the company's historical growth is due to its active participation with the National Precast Concrete Association and the networking relationships fostered with other precasters. Just looking around the new facility, you'll notice NPCA member products have an active presence over nonmember brands.

"I personally prefer to use NPCA members," Camp said. "When it comes down to a choice, we're going to use the NPCA member every time. I have had companies become members because we wouldn't buy from them.

"It's really important to us and NPCA has been integral in our growth."

The design and function of the facility is also fashioned around ideas brought back from visiting other precast plants. For instance, the batch plant concept came from Wieser Concrete Product's plant in Maiden Rock, Wis., while adding a steel plate on the floor of the production area came from Lindsay Precast's plant in Canal Fulton, Ohio. He said everything came together by asking the right questions and seeing how Camp Precast could make products other precasters are manufacturing.

Now that the new facility is in full production, next steps include working to accommodate employee needs and wants for organizing work areas and focusing on improving employee training, a must for keeping employee retention high.

> "We try to create a family atmosphere that makes our employees enjoy their time here, so they don't feel like a number."
>
> – **Kevin Camp**, *owner*

"Many of our new employees do not start off with the skill set or that intuitive, hands-on work experience that we were trained with growing up," Kevin said. "So, it's more important than ever to have the NPCA training courses. We make it a tradition to bring at least one employee with us to the Convention or The Precast Show to attend education courses and work toward their Master Precaster certification."

Currently, Camp Precast has three Master Precasters – Kevin's son, Ethan Camp, Brousseau and Lance Lawyer, quality control manager.

"We are extremely fortunate to have as many long-tenured employees as we do," Kevin said. "We try to create a family atmosphere that makes our employees enjoy their time here, so they don't feel like a number. Our employees' welfare is very important to Travis and me, and I am very proud that I consider many of our employees as extended family and friends."

NOT DONE EXPANDING

Amidst the growing pains felt from the expansion and the rewards already received, Kevin and Brousseau are already thinking about other expansion opportunities. Ideas include manufacturing more bridge components and branching into the accelerated bridge construction market or even giving back more to the industry by participating in NPCA product committees.

"You think that growth is good, but when you get to one stage – it's just not big enough," Brousseau said. "It seems like nothing is big enough."

Whatever exciting decisions lay ahead for Camp Precast, one thing is true – none of it would have been possible without founder and patriarch Dale Camp's grand aspiration to be a precaster. When he passed away in June 2017, Kevin said the finale of his life's

NPCA file photo

Ethan Camp, Kevin Camp's son and third generation, holds a Master Precaster designation along with Travis Brousseau, part-owner and general manager, and Lance Lawyer, quality control manager.

> "Who knows what the market will look like 10 years from now. It's nice to know, however, that we are ready to find out."
>
> – **Kevin Camp**, *owner*

work was driving him through the new plant one last time while on the bed of one of Camp Precast's boom trucks. Now that Kevin's son, Ethan, has joined, the third-generation is already gearing up to take the company even further.

"Precast is taking over many different areas," Kevin said. "The market share grows because of the product mix. We precast a lot of items today – like light poles for example – that were traditionally cast in place.

"Who knows what the market will look like 10 years from now. It's nice to know, however, that we are ready to find out." **PI**

Sara Geer is NPCA's internal communication and web manager, and is managing editor of Precast Inc.

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Working For You

Year in Review

By Mason Nichols

Throughout 2017, the NPCA professional staff worked diligently to expand the use of quality precast concrete products by converting specifications, participating in codes and standards meetings, exhibiting at trade shows, presenting to students and specifiers and placing targeted advertisements across a variety of communication channels.

Staff members traveled across the U.S. to conduct in-person presentations for specifiers at engineering and architecture firms and for students at universities. Late in the year, in the span of just one month, staff members led 17 presentations attended by more than 700 people. And while the number of people trained on the advantages of precast concrete made a difference this year, the knowledge being disseminated and the connections made will likely have a tremendous future impact.

Claude Goguen, P.E., LEED AP, director of sustainability and technical education, explained the importance of spreading the message of precast, particularly among college students.

"The majority of students hardly ever hear about precast, if they hear about it at all," he said. "We've spoken to students in engineering, architecture, construction management and concrete industry management programs. The curricula for most of those students does not include anything on precast."

Students have been highly engaged in these presentations, asking questions, following up for more information and signing up for NPCA Student Memberships. Goguen noted that he can often see the effect his words have during his presentations.

"I see light bulbs go on," he said. "I talk about a precast application such as paving slabs or something that's a little more unorthodox, and students begin to nod as if to say, 'Oh, I never thought of that.'"

Opening students' eyes to the versatility of precast concrete has been very successful, but an additional focus of this effort is fostering relationships between schools and NPCA Producer Members. By having a local partner in the precast industry, a school can work directly with a manufacturer to coordinate plant tours, assist with lab work and more. At the University of Wisconsin-Stout in Menomonie, Wis., Goguen connected Andy Wieser, president of Wieser Concrete Products in Maiden Rock, Wis., with a professor in the school's construction management program. Students in the program had previously built their class projects out of wood and masonry, largely due to a lack of knowledge about concrete. Through their partnership with Wieser Concrete Products, the school now will be able to not only learn more about precast, but also gain practical experience with it as well.

"Hopefully, this relationship will continue to flourish and grow for many, many years," Goguen said.

NPCA remains committed to championing the use of precast concrete through varied approaches and endeavors, and will continue to target both the specifying and student communities throughout 2018. **PI**

Mason Nichols is the managing editor of Precast Solutions magazine and is NPCA's director of strategic outreach.

Claude Goguen, P.E., LEED AP, presents to a group of students at Ball State University in Muncie, Ind.

Impact in 2017

The following metrics are just a few of the ways we track these efforts and are projections for the end of 2017 based on data available as of Nov. 30, 2017.

SPECIFICATIONS REVISED:	SPECIFIERS TRAINED:	STUDENTS EDUCATED:	MARKETING IMPRESSIONS:	NEW SOCIAL MEDIA FOLLOWERS:	ADDITIONAL VISITS TO PRECAST.ORG:
15	1,639	703	9,260,647	12,605	131,383

PRECISION REQUIRED

150 tons of precast prove to be an **unbeatable solution** for a homeowner's high-tech groundwater distribution and management system in central Colorado.

By Shari Held / Photos courtesy of Oldcastle Precast

Oldcastle Precast's Loveland, Colo. plant fabricated all the precast concrete components for a Colorado homeowner's elaborate landscaping design project.

For a central Colorado homeowner's dream home – including an elaborate landscaping design – to become a reality, the primary building material for the landscaping project needed to fulfill both an aesthetic and functional purpose. The homeowners not only envisioned a stream meandering around the seven-acre property through three waterfalls, but also wanted a way to keep the water flowing – even when the irrigation ditch runs dry – and manage the flow speed remotely. In addition, the water needed to be distributed and managed from four distinct sources and the water level controlled from seven separate locations.

"There were a lot of moving parts with this project," said Todd Hunter, owner of waterwell and pump installation company Boulder GWS in Boulder, Colo. "The design is about 30% aesthetics and 70% pure function."

The 150 tons of precast concrete elements fabricated for the project made all of it possible.

A SIZEABLE SCOPE

Hunter's groundwater distribution and management piece of the $17 million overall renovation took slightly more than 18 months to complete. The project includes many components for flow and recirculation, including a precast vault and three precast storage tanks. Piping was also installed around the perimeter of the property for water and electrical as needed.

"All the circuits can swap from a city water supply, to a well supply, to a stored supply to a pond supply," Hunter said. "There are multiple layers of functionality."

The pumping equipment allows the precast tanks to be filled at different values, ensuring the owners won't exceed the allowed amount of water the state of Colorado lets them pump from the water wells.

1. The precast components were delivered in eight loads on flat-bed trucks.

2. Traffic control required a minimum of 9 feet passable street space.

3-6. Workers installed the precast tanks and vault in 1 1/2 days. The products were installed like an assembly line.

7. The installation crew worked 4 feet below groundwater. The water was continuously pumped out of the excavation area until the job was fully installed.

8. Precast concrete fulfilled both the project's aesthetic and functional requirements.

"You have three large, heavy tanks and a pump vault that **have to match** all those pipelines and elevations. It was a **pretty technical** job."

– Matt Lahrs, *Oldcastle Precast*

PRECAST: MATERIAL OF CHOICE

Hunter didn't consider any material other than precast concrete for the three 10,000-gallon storage tanks and pump vault. He has completed a number of similar infrastructure projects where precast concrete was his material of choice.

"I could cast in place, but how would I do that below groundwater?" Hunter said. "How would I achieve the necessary quality control? And how would I complete it in a timely fashion?

"All those challenges indicated precast was the best way to go about it. Precast is really hard to beat."

A DEMANDING FABRICATION PROCESS

Oldcastle Precast's Loveland, Colo. plant produced the precast components for the project. All components were fabricated with 6,000-psi concrete and reinforced with steel rebar – mainly 5/8-inch diameter.

Each tank component consisted of four elements: tank, lid, riser and riser lid. The tank alone measured 21 feet, 2 inches long by 9 feet, 10 inches wide and 9 feet, 6 3/4-inches tall, including lid. Altogether, the tank and lid weighed 72,500 pounds. The risers were fabricated with cast-in aluminum hatches for easy access. With the risers, the height of a tank was nearly 13 feet.

Oldcastle used an adjustable steel form that can produce tanks ranging in size from 5,500 to 15,500 gallons to produce the one-piece bottom that each storage tank boasts.

"That's rather unique for the Western United States," said Matt Lahrs, estimating and sales for Oldcastle Precast, Loveland, Colo., noting that one-piece-bottom tanks are a specialty item for the NPCA-certified plant. These tanks are typically used for car washes and as water storage for fire safety in the mountains.

Since the form and the resulting tank are so large, workers set up the form in a custom pit in the ground.

"That's so we can get the height to pull the product out of the form after it's produced," said John Hirsbrunner, site manager of Oldcastle Precast's Loveland and Platteville, Colo. plants.

Once the form setup passes a series of quality control inspections, it's ready for the concrete to be poured the following day.

"There's a lot of yards of concrete in each pour," Hirsbrunner said. "We pour it first thing in the morning to get a nice, solid continuous pour so we don't have a cold joint in the concrete."

The manufacturing challenge was to ensure all the openings would line up perfectly with the piping. There was very little room for error.

"You have three large, heavy tanks and a pump vault that have to match all those pipelines and elevations," Lahrs said. "It was a pretty technical job."

It took Oldcastle six months and nearly 15 versions of drawings to ensure everything would match up.

"We had to build it right," Hirsbrunner said. "There was a lot of engineering involved. Not just our engineers, but all the engineers involved with the project had to work together to make that happen."

Rather than include the openings in the fabrication process, Oldcastle opted to core them after the tank was taken out of the mold to ensure the required precision was met. Coring also streamlined the process.

"If we had had to identify where every single hole needed to be prior to production, we'd probably still be in the design phase with Oldcastle," Hunter said.

Aluminum panel forms were used for the pump vault. It consisted of the base, riser and a lid. The lid also served as the base of the control building, which was built over the vault. The pump vault measured 11 feet, 4 inches long by 9 feet, 4 inches wide by 12 feet tall and weighed approximately 60,000 pounds.

In July 2017, Oldcastle delivered the precast elements to the job site in eight loads on flat-bed trucks.

PUTTING IT ALL TOGETHER

Installing the precast tanks presented major logistical challenges. The property is located in an urban neighborhood, and Hunter had to keep the impact of the construction to a minimum. The 265-ton crane used to lift the tanks and place them 13 1/2 feet below ground, through the trees and on the other side of the fence had to be positioned on a city street. Traffic control required a minimum of 9 feet of passable street during the process.

"We crowded that crane as tight as we could get it to the curb and came in at 9 feet, 2 inches," Hunter said.

The pumping equipment had to be put together and placed as a package systematically. In addition, the technical aspects of placing the tanks so the pre-manufactured, flanged piping was accurately lined up was as exacting as anticipated.

"The placement had to be precise," Hunter said. "By precise I mean exactly correct. All the pre-manufactured pieces had to mate up like a big tinker toy set."

Workers used 2-foot jigs to lay the pieces so there would be a consistent separation between each. Everything was built perpendicular and square to that center.

"You measure once and put it all together," Hunter said.

And the conditions weren't ideal. The installation crew had to work 4 feet below groundwater. Water was continuously pumped out of the excavated area until the tanks and pump vault were fully installed, plumbed and backfilled.

Despite the challenges, it took workers only 1 1/2 days to install the tanks and vault. The installation was coordinated like an assembly line – once the precast elements were set in position, the fittings slid into place.

"Precast afforded us the luxury and opportunity to spend our energies doing a concise design to allow for a streamlined installation," Hunter said.

A JOB WELL DONE

"If I were an architect I'd use a lot more concrete," Hunter said. "It's robust. The mass is there.

"It's sensible. It's not insanely expensive. It's obviously readily accessible. And fabrication and installation, once you get past the design phase, is generally pretty quick."

He also has nothing but praise for the Oldcastle team that helped ensure that piece of the project was a success.

"They are awesome," Hunter said. "They performed impeccably on a difficult project with a high level of detail."

Oldcastle enjoys the opportunity to overcome new challenges.

"Working with Todd is a pleasure," said Lahrs, who has worked with Hunter on two previous projects. "He gets some of the most unique jobs I've ever seen. It's wonderful to get such unusual jobs and be able to work through the technical difficulties to make it work." **PI**

Shari Held is an Indianapolis, Ind.-based freelance writer who has covered the construction industry for more than 10 years.

PRECAST FORECAST

Moderate Growth Expected Through 2018

For all the talk about rebuilding the nation's infrastructure, it's not happening yet – at least at the federal level. And that simple fact is driving a moderate Precast Forecast for 2018. NPCA expects the industry to grow about 3% in 2018, bringing total sales to $19.1 billion. This comes on the heels of steady growth of nearly 2.5% in 2017.

While there has been much discussion over how to define the scope and also finance President Trump's proposed $1 trillion infrastructure build, there has been no relevant legislation to date. For precasters, that indicates that any meaningful work related to an infrastructure package will not likely come until 2019 or 2020. At the local level, however, widespread support for rebuilding infrastructure has led to the passage of bond issues for roads, bridges, schools, sewer systems and stormwater control – all good news for the precast concrete industry.

LOCAL AND REGIONAL MARKETS

In the 2016 elections, voters across the country passed transportation funding ballot measures totaling $201 billion, according to the American Road & Transportation Builders Association. Those projects should filter down to the contractor level in 2018, which means there should be additional work to bid on for precasters in those areas of the country. School bond issues passed in 2016 are also leading to billions of dollars in new construction throughout the country, especially in Texas, California and Colorado. Long-term sewer and stormwater projects to comply with EPA mandates are also continuing in many rustbelt cities, with most of these initiatives projected to last into 2020 and beyond.

"The bad news is that we do not yet have a national initiative to rebuild our infrastructure," said Ty Gable, NPCA president. "The good news is that many states and cities are doing it on their own. So, while public works construction is flat at the national level, we're still seeing some growth through these local projects."

> "The **bad news** is that we do not yet have a national initiative to rebuild our infrastructure. The **good news** is that many states and cities are doing it on their own."
>
> – Ty Gable, *NPCA President*

The slow-but-steady growth figures over the last few years indicate that the rebound from the Great Recession has entered a mature phase, according to Robert Murray, chief economist at Dodge Data & Analytics. Speaking at the 79th Annual Dodge Construction Outlook conference in Chicago on Nov. 1., Murray said the rate of expansion has slowed, which is expected several years into a recovery.

Murray added that there is ample evidence to suggest the construction industry still has room to grow in 2018. It just won't be growing as fast. During the Great Recession, the precast industry lost about 40% of its sales volume, according to the annual NPCA Benchmarking Report. Recovery started in 2011, and from 2012 to 2016, the industry regained about two-thirds of that lost sales volume.

"As an industry, we're experiencing slow and orderly growth, and many precast companies are doing quite well," Gable said. "There is also a lot of optimism on the horizon in terms of taxes and regulation that Congress is pledging to address."

Factors such as a tax bill that would reduce rates for many precast companies and streamlined regulation that would speed up the start of major construction projects are positive indicators for the future, Gable said. But even if Congress acts now, those changes would not have a major impact until 2019 and beyond.

With the potential for such major changes on the horizon,

forecasting beyond 2018 gets a bit murky. At the economic outlook conference, Murray noted that when looking at construction cycles over the last 50 years, the current recovery appears to be nearing its peak. Unlike the Great Recession, where the housing collapse nearly derailed the entire economy, the next recession should be relatively routine.

"No categories are overbuilt," Murray said. When a downturn comes, "it will be relatively mild. And it's also possible that once a peak is reached, the current cycle will remain close to that level for several years."

As for the precast concrete sector, a mild construction recession in 2019 or 2020 could be offset by the passage of an infrastructure bill in 2018 that would provide substantial opportunities in a wide variety of product categories in the years to come.

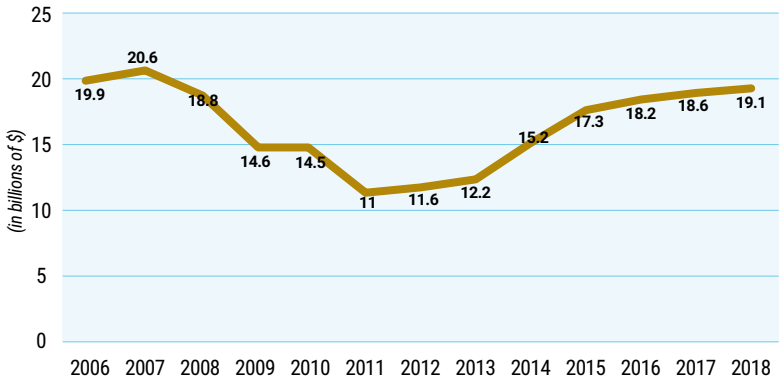
SECTOR BY SECTOR

The NPCA Benchmarking Report divides the precast concrete industry into six major product groups: building and landscaping, sanitary and stormwater, transportation, utility and industrial, water and wastewater, and other. Five of the six product groups registered slight growth between 2015 and 2016. The water and wastewater category, which includes grease interceptors and septic tanks, fell back less than 1% from $1.23 billion in sales to $1.22 billion. So, while other categories are tracking in line with the orderly growth of the construction industry, water and wastewater lags slightly behind.

"It's an indicator of the stiff competition with other materials in that sector," Gable said. "We can say that we're holding our own, but it is obvious that we need to continue a strong push in this area to defend our market share and potentially increase it." **PI**

PRECAST INDUSTRY TOTAL SALES (2006-2018)

INDUSTRY ESTIMATES FOR U.S. AND CANADA



2017 sales are projected; 2018 sales are estimated

PRECAST INDUSTRY SECTORS (2016-2018)

(Estimated sales in millions of $)

Precast Product Group	2016	2017	2018
Building and Landscaping Products	2,939	3,004	3,106
Sanitary and Stormwater Products	5,007	5,187	5,344
Transportation Products	3,009	3,065	3,157
Utility and Industrial Products	4,418	4,632	4,770
Water and Wastewater Products	1,233	1,223	1,232
All Other Precast Products	1,469	1,498	1,543

2017 sales are projected; 2018 sales are estimated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Jared Schimmelpfenning:

Light Years Ahead

Internship opportunities have prepared **NPCA Foundation** scholarship recipient **Jared Schimmelpfenning** for a **successful** career.

By Mason Nichols

Jared Schimmelpfenning

Jared Schimmelpfenning **thanks** the NPCA Foundation Board and NPCA members who donate to the Foundation and sponsor scholarship recipients. "The Foundation is very interested in **scholarship recipients'** well-being and **success**," he said. "It's been a great experience, so **thank you** to everyone involved."

Concepts presented in the classroom often establish the foundation from which students develop an understanding of their skills and interests in their areas of focus. But when it comes to building a career after graduation, academics are no longer the top concern for employers. Instead, a different approach to learning – one that provides students with hands-on knowledge – continues to gain prominence. More than ever, employers are seeking candidates with internship experience.[1]

NPCA Foundation scholarship recipient Jared Schimmelpfenning, a senior in the construction engineering and management program at Purdue University, recognized this early in his academic career. He secured an internship in 2015 with Kiewit working on the large-scale DFW Connector project in Texas, as reported in the January-February 2016 issue of Precast Inc. Since then, he has partnered with Kiewit for two additional internships, including his most recent experience in Honolulu, Hawaii, as part of the Halona Street Bridge demolition and replacement project.

Schimmelpfenning said while the work for the bridge replacement project is on a smaller scale than the DFW Connector project, the reduced size allowed for additional learning opportunities.

"Being that this was a smaller project, I had my hands in all the different corners of everything going on," he said. "There were only four staff members, but since this was my third summer working with Kiewit, I felt I had built up to it and that I was ready to take on the challenge. I learned a lot."

Schimmelpfenning's responsibilities included owner/client communication, submittals, requests for information, coordination with subcontractors and suppliers, scheduling and more. Because of the small staff size and rapid pace of the work, the position continued to evolve over the summer, which is crucial for his career.

"The experience is exactly what I needed this early in my career," he said. "I just need to sponge up as much information as I possibly can from all the different projects I work on and all the different people I work with."

Schimmelpfenning worked extensively with precast concrete products on the Halona Street Bridge project.

In addition to learning more about construction management, Schimmelpfenning acquired new information about precast concrete products, particularly about the piles that serve as the bridge's foundation. Although he wasn't present to see the piles installed, he spoke at length with the project team about why the piles were selected and how they would benefit the bridge during its service life. Schimmelpfenning also learned more about precast from working directly with NPCA Producer Member GPRM Prestress on the project.

"I got a chance to go out to their plant a few times and do some material and quality inspections on our bridge planks before we received them on-site," he said. "I interacted with the employees out there on those days. They were all very friendly and knowledgeable."

Overall, Schimmelpfenning's internship experiences offered him a great deal of expertise that he believes would not have been acquired from classroom work alone. He said he's improved his organization, time management, professionalism and communication skills while working with Kiewit. He also feels that he will be in a better position than some of his peers when seeking employment after graduation.

"As a college student, my internships have me light years ahead of where I would have been if I didn't get the opportunity to work in the industry starting with my freshman year," he said. "Compiling my three internships, I have an entire year of experience in the industry over someone else who might not." **PI**

Mason Nichols is the managing editor of Precast Solutions magazine and is NPCA's director of strategic outreach.

RESOURCES:

1 theatlantic.com/business/archive/2014/08/the-thing-employers-look-for-when-hiring-recent-graduates/378693/

Build Your INTERNSHIP PROGRAM

Are you interested in starting an internship program at your plant? The NPCA Foundation, in partnership with the PCI Foundation, has developed an internship template that can be used to launch your program. The template covers a wide range of topics, including legal considerations, the benefits of hiring an intern, recruitment and more.

To download the template and view additional resources, visit precast.org/internships

If you've already established your program and are looking to hire an intern, you can also post open internship positions using the above URL.

People & Products

People & Products is a **forum** where NPCA members and nonprofit organizations can **share information** on new products, personnel promotions, acquisitions or service announcements **concerning the precast concrete industry**. Items are printed on a space-available basis.

For possible inclusion, send your press releases and photos to sgeer@precast.org.

AYAZ AHMED JOINS GARDEN STATE PRECAST

Ayaz Ahmed

Ayaz Ahmed has been named vice president of manufacturing and engineering at Garden State Precast in Wall Township, N.J. Before coming to Garden State, Ahmed was an associate professor in the Concrete Industry Management Department at Middle Tennessee State University. He has broad manufacturing experience and has served in past positions as director of manufacturing, vice president of operations, project executive and president at mid- to large-size precast concrete operations.

HAWKEYEPEDERSHAAB CONCRETE TECHNOLOGIES MERGES WITH BFS

HawkeyePedershaab Concrete Technologies Inc. announced its merger with BFS Betonfertigteilesysteme GmbH. Through this partnership, HawkeyePedershaab will expand its presence in the concrete pipe and manhole machinery segment, and offer new product lines serving the pressure pipe, manhole, pole plant, and block and paver end markets. BFS is co-led by Daniel Bühler and Klaus Mueller, who will continue with the business.

GCP APPLIED TECHNOLOGIES LAUNCHES NEW CEMENT ADDITIVES, NEW MICROFIBER BRAND NAME

GCP Applied Technologies Inc. launched two new cement additives, OPTEVA HE quality improvers and TAVERO VM grinding aids.

- OPTEVA HE quality improvers are cement additives that provide options for gaining higher early strength and are particularly effective for challenging cements.
- TAVERO VM grinding aid additives help stabilize vertical roller mills during production by reducing water injection requirements and cement pre-hydration, while at the same time improving cement performance by delivering higher strengths and shorter setting time.

The company also announced its line of synthetic microfiber products, previously sold under Grace Fibers, Grace Microfibers, Grace Microfiber FDS and Gilco Fibers, will now be marketed under the new brand Sinta. The newly named product line includes Sinta F (fibrillated), Sinta M (monofilament) and Sinta FDS (fluid delivery system) synthetic microfibers.

HILL AND GRIFFITH COMPANY ANNOUNCES NEW HIRES, PROMOTION

Doug Schwall

Angela Cox

Rodney Schisler

Mike Lawry

Hill and Griffith Company hired three new technical sales representatives: Doug Schwall, Angela Cox and Rodney Schisler.

Doug Schwall has been hired for the Northern Indiana territory for sales. His duties will include concrete and machining with an emphasis on new customers and growth to existing accounts in the area. Angela Cox has been hired for the Northern Illinois/Wisconsin territory for sales, with 15-plus years of industrial chemical sales experience. In addition, Rodney Schisler has been hired for the

Southwest Ohio territory for sales. His duties will include concrete and machining with an emphasis on new customers and growth to existing accounts in the area.

The company also promoted Mike Lawry to vice president of sales and operation after 26-plus years with the company.

MOLDTECH DESIGNS PRECAST CONCRETE MOLDS FOR PORTUGUESE GROUP

Precast Concrete Hydraulic Molds

Moldtech designed, fabricated and commissioned two precast concrete hydraulic molds for columns for the Portuguese group Mota-Engil. The molds commissioned by Moldtech have double production lines and adjustable sections, and will help the client cope with increased demands for industrial building construction. The molds have been installed by Moldtech technicians in Mota-Engil's main precast plant in Nelas, Portugal.

J-J HOOKS FREESTANDING PRECAST CONCRETE SAFETY BARRIER NOW MASH TL3 COMPLIANT

Easi-Set Worldwide announced the completion of MASH TL3 testing of its newly designed freestanding precast concrete safety barrier.

This new J-J Hooks freestanding barrier, along with the previously MASH TL3-tested J-J Hooks restrained barrier, is fully compliant with MASH TL3 requirements. Their availability in the marketplace is two years ahead of the sunset date requirements contained in the Jan. 7, 2016, AASHTO/FHWA Joint Implementation Agreement for MASH. The new MASH freestanding design will eventually replace the NCHRP 350 TL3 design originally tested in 1999. **PI**

CALENDAR OF Events

Feb. 22-24, 2018
THE PRECAST SHOW 2018
Colorado Convention Center
Denver, Colo.

Oct. 4-6, 2018
NPCA 53RD ANNUAL CONVENTION
Omni Providence Hotel
Providence, R.I.

Feb. 28 - March 2, 2019
THE PRECAST SHOW 2019
Kentucky International Convention Center
Louisville, Ky.

Oct. 3-5, 2019
NPCA 54TH ANNUAL CONVENTION
Hyatt Regency Seattle
Seattle, Wash.

For the most up-to-date information about NPCA events, visit
precast.org/meetings

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