Top Ten Sustainability Benefits of Shotcrete

The United States Green Concrete Council's (USGCC) book, *The Sustainable Concrete Guide—Applications*, includes a list of the top 10 sustainability benefits of shotcrete in its chapter on shotcrete. Over the next 10 issues of *Shotcrete* magazine, this Sustainability column will elaborate on each one of the listed advantages. Previous discussion of advantages from past issues can be viewed on the ASA website at **www.shotcrete.org/sustainability**.

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1. Formwork savings of 50 to 100% over conventional cast-in-place construction.
2. Formwork does not have to be designed for internal pressures.
3. Complex shapes require very little—if any—formwork.
4. Crane and other equipment savings or elimination.
5. Labor savings of at least 50% in repair applications.
6. New construction speed savings of 33 to 50%.
7. **Speed of repair reduces or eliminates downtime** (see below).
8. Better bonding to the substrate, which enhances durability.
9. Adaptability to repair surfaces that are not cost-effective with other processes.
10. Ability to access restricted space and difficult-to-reach areas, including overhead and underground.

Speed of Repair Reduces or Eliminates Downtime

When servicing the industrial market, fitting work into short time frames is the nature of the beast. The work must be completed within windows of opportunity—that is, when the production units are temporarily out of service. In the words of Arthur Miller, "It comes with the territory." During an outage when a boiler, vessel, metal mixer, or cement kiln is "down" for scheduled repairs, *all* needed repairs are squeezed into the short time duration of the shutdown. The "critical path" dictates the time frame where all routine maintenance, repair, renovation, or upgrade operations must fit into this compressed time frame (Fig. 1 and 2).

Why the tightly controlled and compressed schedule? As one may suspect, it comes down to money. The lost production time during a shutdown often costs the owner more than the

Fig. 1: In plant outage work, at facilities such as the Homer City Generating Station pictured here, shotcrete can provide an efficient method of installing refractory

Fig. 2: Lost production time at large power plants, such as the Harrison Power Station pictured here, can be extremely expensive and repair work must be compressed into the time allotted in the scheduled outage

cost of the repairs. Industrial clients consider the lost revenue while the unit isn't in production an additional cost. In large power plants, the loss of power generation can be as high as $1,000,000 a day, if not higher. The same can be said for blast furnaces, coke plants, vessels, and most other high-output industrial production units. Therefore, getting a unit back into service a few days to a week early can make an enormous difference to the owner's costs for repairs.

To further complicate this, in many cases, the lion's share of the allotted downtime is often used for mechanical and structural repairs that must be completed *prior* to the start of shotcrete work. This further shrinks the open window to complete shotcrete repairs. Thus, the speed of repair in using shotcrete becomes a tremendous advantage. In power plant outages, unforeseen problems are often discovered after the shutdown is started and must be addressed before the shotcrete can be placed. Adding this additional newly discovered work can again compress an already tight schedule for shotcrete placement (Fig. 3).

Performing a complete ash hopper refractory reline on the last few days of a power plant outage is not uncommon. With shotcrete, the refractory material can be quickly placed and finished within 24 to 48 hours. For repair work, the refractory material placement can often be completed in one shift or less. With furnaces, coke plant quench towers, and blast-furnace troughs, the downtime can sometimes be as little as a 4- to 8-hour window. Getting in and out quickly and easily and performing the necessary work becomes a requirement for the job. Using shotcrete is often the only way the work can be accomplished within these tight time constraints. No forms are required, the shotcrete conforms to a variety of shapes, material handling issues are eliminated, and the material can be transported directly to the desired location and sprayed in place—readily and efficiently.

Speed of installation is not just an advantage in industrial applications. In infrastructure repair work on tunnels, ramps, and bridges, heavily traveled arteries are often closed at night or on weekends for emergency repairs. One common example is a scheduled weekend shutdown of a tunnel exit ramp for overhead shotcrete repairs. The ramp is shut down on a Friday night, the deteriorated concrete is removed, the reinforcing bars are sandblasted, steel mesh is installed, and shotcrete is placed overhead in the tunnel. All the work is completed and opened to traffic for the Monday morning rush hour (Fig. 4 and 5).

On projects with tight time frames or a limited amount of time to accomplish the work, the speed and efficiency of installation with shotcrete provides a distinct advantage. Even on projects without severe time constraints, the time, labor, and material savings with shotcrete can produce significant cost savings. Shotcrete provides an invaluable method to efficiently place concrete, refractory, or acid-resistant cements with a speed of installation that would not be possible with any other method. The old adage "time is money" is true for the construction industry, and using shotcrete can help save both on your next project.

Fig. 3: Shotcrete provides a fast, efficient method of installing refractory in power plants and other industrial applications under difficult time constraints

Fig. 4: Dry-process equipment and operator during the shotcrete installation of an underground culvert

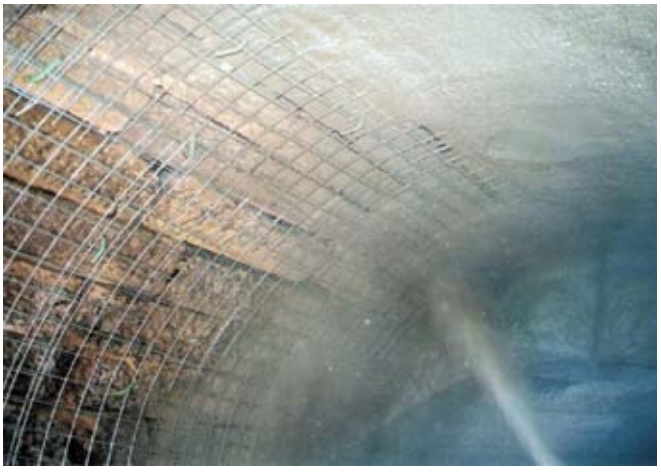

Fig. 5: Dry-process shotcrete being gunned overhead in an underground culvert. The roadway was opened the following day