PIPELINE REHAB À LA CARTE

BY JACK INNIS

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Operators of a Southwestern coal-fired power plant were in a pickle. Along an 1,800-foot (548.64 meter) stretch of 10-foot-diameter (3.05 meter) underground concrete pipeline that comprised the plant's cooling system, 17 of the 20-foot-long (6.10 meter) sections failed internal inspection. The 40-year-old pressure pipe system was comprised from inside out of 2 inches (5.08 cm) of concrete, a steel liner, 2 more inches (5.08 cm) of concrete, a post tension cable wrap, and roughly 2 inches (5.08 cm) of exterior concrete. If the internal failures were not remedied quickly, corrosion could reach the steel liners, and the resultant failure could shut the entire plant down.

Plant managers likely would have ordered the sections dug up and replaced, but there was a rub. The cooling lines ran underneath buildings, equipment, and other structures. With pipe replacement off the menu, the managers began looking at a coatings-based rehab solution, but soon realized that any new coating system would need to be as strong, or stronger, than the original concrete pressure pipe. The fix would be complex. It would likely call for a hydroblast to ICRI CSP-3 surface profile, installation of a 3 - 5 mil (76.20 - 127 micron) (DFT) epoxy primer, hand troweling a 20-mil (508-micron) (DFT) layer of epoxy thickened with fumed silica to fill voids and create a tack coat, installation of a saturated strengthening fabric, laying down 130 mils (3,302 microns) (DFT) of thickened epoxy into which would be pressed in hoop fashion 208-mil (5,283.20 micron) diameter steel wire at 2.5 wires per inch (2.54 cm), and another layer of wetted fabric.

As if this recipe needed more spice, plant managers could only take the cooling system offline for 28 days!

Several contractors eyeballed the project and came to the same conclusion. The short shutdown window, the fact that 17 sections were scattered throughout 1,800 feet (548.64 meters) of pipeline, the amount of equipment needed to work multiple sections simultaneously, and the sheer manpower required made this a losing proposition.

À LA CARTE

Meanwhile, several technical and practical pipeline prep and coatings innovations were coming together that would make this project feasible. In the center of this confluence stood Structural (formerly Structural Preservation Systems or SPS), headquartered in Hanover, Maryland.

Ron Rozek, inventor and 11-year Structural subcontractor, was working on a process to shorten pipeline prep time by removing hydroblasting from the equation. Hydroblasting is a great form of surface prep in situations where the introduction of water is not a problem. Ironically, in this underground water-carrying pipeline, it was.

"Once the pipe is pumped out, the clock starts ticking on a project such as this," says Rozek, who owns the Winneconne, Wisconsin-based Performance Solutions Advantage. "The last thing you want to do is reintroduce water by hydroblasting and then wait for the pipe to dry. On this job, nobody had time to sit around and wait for that."

As part of his gig with Structural, Rozek had done a lot of noodling to find more efficient ways to prep pipelines. In fact, a year earlier he called Ed Zaharias of Stoc Products out of Spring Grove, Illinois and described one of his ideas. Zaharias listened as Rozek talked about putting the entire blast operation onto a motorized gurney with a rotating nozzle—blasting à la carte, so to speak.

LEFT A southwest coal fired power plant relied heavily on robotics to fix 17 sections of 10-foot-diameter (3.05 meter) underground concrete pipeline that comprised the plant's cooling system. A robot controlled abrasive blast machine designed by Wisconsin-based Ron Rozek used Sponge Jet Silver 30 (#30 oxide) to produce ICRI CSP-3 surface profile.

The idea piqued Zaharias's interest. As a distributor for Sponge-Jet, manufacturers of recyclable sponge-coated abrasive media and equipment, Zaharias thought sponge blasting might work well with Rozek's method. So he loaded up a trailer with a Sponge-Jet blaster, recycler, and various blends of sponge-encapsulated media and made the three-hour drive to Winneconne.

Zaharias and Rozek conducted a series of blasts on various pieces of recently demolished coated concrete pipes Rozek had scrounged. The coatings they encountered mirrored field conditions, Rozek says.

"Even within the same pipeline, the coatings can vary greatly from section to section," says Rozek. "It's easy to find yourself over-texturing the concrete with hydroblasting. The more concrete you take off, the more you have to replace and remove from the pipe. It's costly in terms of time and money. With sponge-encapsulated media you could accurately control how much coatings you remove from section to section."

SHORT ORDER

After Zaharias left, Rozek built a beta version of his blast cart set up to work with Sponge-Jet. The cart was powered by direct current motors and electronic controls so that Rozek could ride along or walk behind while controlling linear speed and the direction and speed of the rotating blast arm. He brought three full-sized test pipes into his yard so he could replicate field conditions. He brought Zaharias back, and the two experimented with several iterations before discovering that Sponge Jet's Silver 30 (#30 oxide) produced the desired profile in short order.

ABOVE ▲ Meanwhile, another robotic cart designer Mike Kronz tested his machine inside a plywood pipeline mockup at his facility, also in Wisconsin. His goal was to pair his robotic cart with a Graco Probler P2 Elite internal mix gun to see how efficiently he could install polyurea onto epoxy pipe, on a test basis.

"Sometimes you have to get lucky," says Rozek. "We ran the cart through three, 20-foot-long by 66-inch-diameter (6.10 meters by 167.64 cm) pipes. The first pipe took less than an hour, including cleanup. After all three, we crunched the numbers and found we were averaging 345 square feet (32.05 m2) per hour. In contrast, depending on what other system you used, doing the same work by hand might take six to eight hours."

About that time, Structural contacted Rozek about the Southwest power plant. When he and Zaharias arrived on site, everything was set up for them to work their magic. The entire pipeline was drained and dry. Supply and exhaust fans provided air flow. The duo lowered the blast cart and Sponge-Jet equipment into the pipe, reassembled them, and moved nearly 800 feet (243.84 m) to the failed pipe segment farthest away from the air exhaust. They connected pneumatics to their rigs and began blasting. Rozek and Zaharias quickly discovered one of the biggest problems they'd ever encountered.

I DIDN'T ORDER THAT!

"It was supposed to be bare concrete," Zaharias says. "That's what we were told, and that's how the project was originally bid."

The power plant had no record that the 40-year-old pipeline, had at one point in time, received a 30- to 40-mil (762- to 1,016-micron) epoxy coating. But it had. Judging strictly by looks, it would have been hard to know otherwise.

"Because of the hard water, we had layers of limestone and scale," Zaharias says. "We couldn't see there was a coating underneath and we had no reason to suspect there was one, so it wasn't until we started blasting that we found the epoxy. It just looked like dirty concrete. The epoxy changed everything."

Prior to the blast attempt, estimates showed that the crew could expect to take bare concrete down to ICRI CSP-3 surface profile at a rate of 22 to 23 square feet (2.04 to 2.14 m^2) per minute. If they could finish two sections an hour, they would be making spectacular progress. One and a half sections per hour would be considered great. One section would be barely acceptable.

JOB AT A GLANCE

PROJECT:

Abrasive blast and apply epoxy-based lining system to 17 failed 10-foot-diameter (3.05 meter) sections of concrete pressure pipe at a coal fired power plant

COATINGS CONTRACTOR:

Structural Technologies
7455 New Ridge Road, Suite T
Hanover, MD 21076
(410) 859-6539
www.structuraltechnologies.com

SIZE OF CONTRACTOR:

Two coatings crews worked this project, totaling about 30 men

PRIME CLIENT:

Power plant in the Southwest that wishes to remain unnamed

SUBSTRATE:

40-year-old concrete pipe with steel casings and tension wire sandwiched inside

SUBSTRATE CONDITION:

Seventeen 20-foot-long (6.10 meter) sections failed inspection

SIZE:

About 10,000 square feet (929.03 m^2)

DURATION:

28 days

UNUSUAL FACTORS:

- Plant could be taken off line only 28 days
- Extensive use of robotic carts
- Crews encountered mysterious preexisting 30 – 40 mil (762- to 1,016-micron) epoxy coating that was not part of original bid

MATERIALS/PROCESS

- Use motorized cart to blast Sponge-Jet encapsulated media to achieve ICRI CSP-3 surface profile
- Spray apply single pass of 3 - 5 5 mil (76.20 - 127 micron) (DFT) Structural VWrap 700 epoxy primer
- Hand trowel 20-mil (508-micron) (DFT) layer of VWrap 700 thickened with fumed silica to fill voids and create a tack coat
- Hand apply saturated strengthening fabric
- Lay down 130 mils (3,302 microns) (DFT) of thickened epoxy VWrap 700
- Use motorized cart to install in hoop fashion 208 mil diameter steel wire at 2.5 wires per inch (2.54 cm) into still wet VWrap 700
- Hand trowel 20-mil (DFT) layer of thickened VWrap 700 to cover wire
- Hand apply wetted saturated strengthening fabric
- On one test section, use motorized cart to spray apply three 32 mil (812.80 micron) (DFT) passes of polyurea

SAFETY CONSIDERATIONS:

- Steel-toed boots, hard hats, safety goggles required
- When working near loud equipment, double hearing protection (ear plugs and muffs) required

"I remember the moment I went topside and told the plant managers there was bad news and good news," says Zaharias. "The bad news is that we were only doing one section an hour. The good news is that there was 30 to 40 mils (762 to 1,016 microns) of old epoxy on the pipe, and were still doing one section an hour. Needless to say, a change order was issued."

Using Rozek's blast cart, the Sponge-Jet # 30 silver oxide knocked the old epoxy off and gave the concrete an ICRI CSP-3 surface profile. The Structural coatings crew then brush rolled a single 3 - 5 mil (76.20 - 127 micron) (DFT) pass of Structural Technologies V-Wrap 700 epoxy, formulated to also act as a direct-to-concrete primer. The two-part 100 percent solids epoxy is mixed by first using a mechanical mixer to premix Part A for two minutes. Part B is then added to the full contents of the Part A pail. Smaller batches may be created by mixing equal portions. After blending Part A and Part B for three minutes until uniformly blended, V-Wrap 700 delivers an approximate pot life of three to six hours at 68°F (20°C). After the primer cured, the crew hand troweled in one pass a 20-mil (508 micron) (DFT) coat of V-Wrap 700 thickened with fumed silica.

A 32-ounce composite structural fabric was then wetted with V-Wrap 700 and installed over the trowel coat. Installing the fabric was a three-man job. One man wetted, rolled, and cut to length. Another installed the fabric. A third used a steel-ribbed roller to press the fabric into the epoxy.

After allowing the coating to set up, the crew hand troweled a single 130-mil (3,302-micron) (DST) pass of silica-thickened V-Wrap 700. Immediately thereafter, Structural mechanically installed a 208-mil (5,283.20-micron) diameter steel wire into the still wet coating. The wire was installed utilizing a wheeled, cart-based machine that slowly moved inside the pipe. The cart was fed via a topside spool equipped with turntable and gooseneck that ultimately dished approximately 3.4 miles (5.47 km) of wire into the pipeline to fortify the pipe restoration. The machine's rotating arm moved at about 4 rpm to bury the wire, in hoop fashion, into the coating to achieve 2.5 wires per inch (2.54 cm). Once wire was in place, the crew troweled another 20-mil (508-micron) (DFT) coat of fumed silica-thickened V-Wrap 700 to cover the wire. The trowel coat was covered with another layer of 32-ounce composite structural fabric.

DESSERT CART

As though this crazy-strong epoxy sandwich wasn't enough, project managers had another course in mind. Polyurea, ordered off the dessert cart!

So they tapped the brains of another Wisconsin-based robot cart inventor, Mike Kronz, who runs Remote Orbital

ABOVE ▲ Robotic carts tend to be scene stealers, but the heavy lifting on this project was accomplished by a crew from Structural who hand-rolled and troweled a proprietary, multi-layered, reinforced V-Wrap 700 epoxy coating system.

ABOVE ▲ It took just the right combination of manpower and robotics to repair this power plant cooling system on time, but the repaired cooling system passed all final tests. The repaired segments now meet or exceed the pipeline's original specifications.

Installations (ROI). For the past 15 years, ROI has focused on rehabbing vertical manholes using a remotely operated coating delivery system Kronz calls SPOD.

"I remember the day Structural called," Kronz says. "They basically said, 'Can you adapt your vertical system to a horizontal cart and deliver it in 10 days?' "

Kronz jumped at the chance. He began immediately by mating one of his vertical SPODs to a horizontal cart. The SPOD was already equipped with a Graco Probler P2 Elite internal mix gun, so no changes were needed there. Kronz then fabricated a rotating extension arm to keep the #6225 spray tip approximately 18 inches (45.72 cm) from the substrate. He rigged up an umbilical system to manage the heated high pressure line and 110 volt electricity to power the cart's spotlights, drive motor, and spray head motor. He fashioned a wireless controller so he could simply hold down a button while keeping an eye on the spray rotation and pattern.

"We had a very short application window on the pipeline project, so we built a plywood mock-up of a 10-foot (3.05 meter) diameter pipe inside our shop," Kronz says. "That way, we could set up and fine tune everything. When that was done, we disassembled the SPOD, shipped it, reassembled it, and dropped it through the 36-inch (91.44 cm) manhole. It took about an hour and a half to set up, and we were soon doing three feet (0.91 meter) per minute. We were out of there in about five hours, total; that included a lot of conversation and back and forth about what we were doing. We only did one section as a pilot project."

THE WHOLE ENCHILADA

Aided by two robotic carts and sponge-encapsulated blast media, the Structural crew finished on time. The power plant pressurized the concrete pipeline, and the repaired sections held. All who worked on the project were satisfied that they had crafted a repair that met or exceeded the concrete pressure pipe's original specifications.

"Underground pipelines like this are almost impossible to replace," says Rozek. "They run underneath structures, and you just can't get to them. That's why it's exceedingly important to have everything working perfectly."

This was a tough job in a lot of ways, Sponge-Jet distributor Zaharias says. Three contractors previously eyeballed the project and couldn't take a bite out of the apple.

"With the help of the robotic carts we now have a process that lets us do a lot of work in a relatively short amount of time," says Zaharias. "Everyone pitched together and did a good job that will last years and years."

Sure, it took a lot of teamwork, hard work, and ingenuity to get the project completed on time. But hey, why leave the power plant operators in a pickle when you can deliver the whole enchilada? CP

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