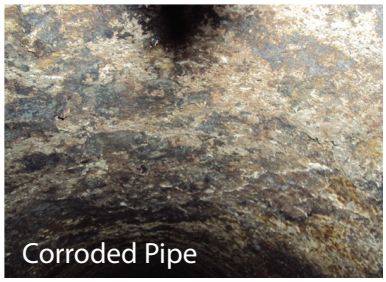
Big Pipe Big Savings for Westlake, Ohio

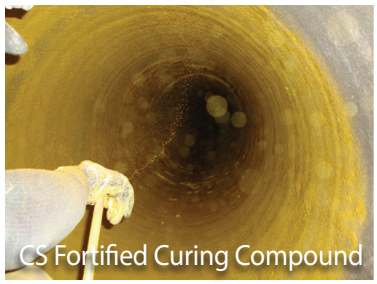
by **Angus W. Stocking**, L.S.

The City of Westlake, Ohio, got an interesting 'wake up call' in 2006, when a sanitary sewer interceptor line in nearby City of Lorain failed dramatically. "It forced the evacuation of several dozen homes for months," says Westlake Director of Engineering Robert P. Kelly, PE, "and we realized we'd better take a closer look at our system, because we have a similar interceptor arrangement in Westlake," he explains, "and our pipe is about as old as theirs." The interceptor in question was built in the 1960s and runs from west to east along Westlake's northern limits, increasing in size from 36-inches to 60-inches. Dozens of 18-inch to 24-inch trunk lines, serving the entire city, drain northerly into the interceptor. The arrangement is efficient and has many advantages. But there are a few weaknesses as well; for one thing, a failed interceptor could affect all of Westlake. "There are about 70,000 people depending on our system," says Kelly, "We simply could not allow a problem to develop."


Corroded Pipe


Pipelining Process


Finished Liner


CS Fortified Curing Compound

Interceptors are also particularly prone to microbiologically induced corrosion (MIC), an insidious plague of concrete sewer systems. In Westlake, the south-north trunk lines dump directly into the interceptor and are constructed with 24-inch drops to keep flows moving quickly, which unfortunately creates a great deal of turbulence. Turbulence, combined with organic waste, warm temperatures, and oxygen, leads to high concentrations of hydrogen sulfide gas. The gas feeds colonies of *Thiobacillus* bacteria which excrete sulfuric acid—some strains of Thiobacillus can thrive in acid concentrations as high as 7 percent. The acid attacks concrete directly, turning it into crumbly calcium sulfate (gypsum). Once established, MIC works from the inside out to destroy concrete integrity in just a few short years.

The interceptor had been cleaned and thoroughly inspected at the 40-year mark. But five years later, the Lorain interceptor failed and Westlake retained URS Corporation to perform video inspection, do detailed analysis, and prepare an emergency evacuation plan in the event of failure. . . just in case. What URS found was disturbing.

"When we inspected at year 40," says Westlake Field Engineer James J. Smolik, PE, "we televised the lines—everything was in good shape." But five years later, URS found significant MIC damage. "We could walk inside the interceptor and chip away concrete," Kelly says, "it was a real problem." MIC had eaten away 1/2-inch to 1 1/2-inches of the concrete pipe's inner surface. "And," says Smolik, "since the pipe thickness is only six-inches, we knew we had a problem."

There was some good news. According to our findings, MIC was confined almost entirely to within 25 feet of trunk line entry points. So, conceivably, Westlake could save money by focusing on problem areas and by leaving the rest of the interceptor alone. In theory, this would save about half of the cost of cured in place pipe (CIPP) rehabilitation, because the overall footage of rehabilitated pipe would be reduced by more than half. "We actually did a whole design based on that idea," says Kelly.

But there were problems with that approach. CIPP is, of course, a well-proven technology for pipe rehabilitation but it was not a good choice for the particular situation in Westlake. For one thing, CIPP runs are generally manhole-to-manhole, and there is not much money saved by specifying shorter, partial runs CIPP is also not a good fit when pipe diameter changes, as it does several times in the Westlake interceptor. And finally, manholes that serve the interceptor are quite deep in places, and they would have to be excavated and dismantled to maneuver in felt linings—this was more work than Westlake wanted to do for a partial rehabilitation.

These small challenges added up to one big problem. Westlake was trying to avoid state or federal money for this project, and had approximately $2 million available. "When we added up all the costs of our CIPP design," says Kelly, "it came to over $3 million! We did not know what to do."

In search of ideas, Smolik attended the Pumper & Cleaner Environmental Expo in Louisville, Kentucky. After a great deal of research and conversation, he returned with two good ones: a new product, and a new technology.

The new product was ConmicShield®, a concrete additive that permanently inhibits MIC. ConmicShield® is a concrete additive that is easily dosed into concrete and bonds molecularly with the concrete. Even though ConmicShield® is not toxic to humans or animals, the treated concrete is anti-microbial, and permanently prevents the growth of *Thiobacillus* bacteria for the concrete's entire lifecycle. ConmicShield® protection is not new; it was used in shotcrete for a major trunk sewer rehab in 1997 in Atlanta. It has since been adopted by a number of very

large municipalities, including Chicago in the world's largest manhole rehabilitation project to date.

Centri-Pipe® (centrifugally-cast concrete pipe) lining technology is offered by AP/M Permaform. In essence, Centri-Pipe® is a way to centrifugally apply a layer or multiple layers of high-strength structural grout onto deteriorated pipe interiors at diameters ranging from 30-inches to 120-inches. The grout products developed by AP/M Permaform are designed specifically for structural reinforcement, long pumping distances, rapid curing for quick return to service and high build of pipe crowns. The grout is packaged in small sacks or large bulk bags for easy handling and consistently precise mixing. Centri-Pipe® is also not completely new—AP/M's patented variation called Permacast® has been used in manhole rehabilitation since 1990 and Centri-Pipe® in sanitary sewers since 2002; however, the Westlake interceptor was one of the first applications of this magnitude in horizontal pipe.

Using Centri-Pipe® technology to apply ConmicShield®-treated cementitious grout looked like a good way to overcome the challenges Westlake was facing. Centri-Pipe® is a truly trenchless rehabilitation technology, and since the equipment can be introduced to pipe interiors via manholes, excavation is avoided. More importantly, the SpinCaster can be started and stopped at any point in the pipe, and adjusted as needed for changes in diameter—it looked like a perfect way to focus on the interceptor's problem areas, and realize the savings city officials were looking for.

"We thought it would work, so we put it to bid," says Kelly, "There were not a lot of contractors who could do this, but we found one… and the total costs came in at $1.6 million. We saved at least $1.5 million by avoiding rehabilitation of the undamaged pipe."

A job done right

Contractors diverted flows around individual trunk line entry points by using 12-inch pumps to move waste overland. The pipe area that was subject to rehabilitation was cleaned and scoured with a high-pressure spin washer to remove loose material. As a final step before applying new grout, Westlake designers called for a ConmicShield® rinse of the cleaned interior to be certain MIC could not develop behind the new liner.

After analyzing the interceptor's interior diameter, water load, extent of damage and other factors, engineers determined that a half-inch liner of PL-8000 grout with ConmicShield® would be optimum. This would repair and strengthen the interceptor, and prevent corrosion while preserving flow characteristics.

In all, Westlake rehabilitated just 3,961 lineal feet of interceptor, as opposed to the 7,200 lf that would have been required by manhole-to-manhole rehabilitation. The work began in 2009 and was completed about a year later; this meant that seasonal adjustments had to be made as the work progressed. "The work went on during sub-zero days and when it was 90º in summer," explains Smolik, "The contractors learned to use hot water in winter, and on some hot days they actually put ice in the mix!"

Smolik did quality control by paying attention to the amount of dry mix used as work was done. He would calculate the amount needed per foot of rehabilitated pipe, and would check that the right amount had been used as work was performed. By watching the mix, and spot checking as needed, he could be sure that an even 1/2-inch was being applied. If the amount of dry mix used appeared to be off, sections of pipe were cored to verify thickness and patched as needed.

Kelly notes that as the year progressed, the contractor grew more and more proficient; "Toward the end of the project," he says, "they could line about 350 to 500 feet a day—very impressive."

Innovation pays off

Trying relatively new techniques and products is not always a comfortable position for city engineers, but the Westlake interceptor project shows that the rewards can be huge. "This cost less than half of what the manhole-to-manhole cost would have been," says Kelly, "and I believe the finished product is at least as good, maybe better. Because of this savings, we were able to use our own funds, and do the work within a year. Those are huge wins!"

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