Battling PIPE CORROSION

Restoration technology helps solve pipeline and wastewater infrastructure problems

By Karl Sauereisen and Tony Oswald

Over the years, technological advances to combat corrosion in the wastewater industry have mirrored the shift in mindset from treating these systems as a line item expense on a budget to one of asset management. As such, this article reviews different approaches of corrosion technology through three separate and distinct methodologies, including case study examples from Miami and Middlesex County, N.J.

Membrane and monolithic technology

The workhorse of membrane/monolithic technology is a potassium-silicate refractory gunited 2 in. thick. This acid-proof concrete monolithic exhibits excellent chemical resistance, but fairly high porosity. As a second line of defense, a low-permeable membrane is sprayed beneath it as a final layer of protection from chemicals that may find their way through the outer surface. Chronologically, the 1/8-in. thick urethane membrane is applied first, followed by the gunited refractory.

This technology has been used extensively in flue gas environments for decades, particularly in the power industry. One of the earliest installations in a wastewater environment occurred at a major project in Miami in 1987. The project involved a 750-ft-long box culvert functioning as a conduit between two sewer lines running parallel with I-95. The culvert ran underneath the highway and enabled sewage to be diverted from one line to another during overflow situations.

Because the conduit was generally in a low-flow condition, extensive corrosion of its top half, or "crown", had occurred. This is typical in municipal wastewater, where acid-producing bacteria thrive in the vapor zone above the water level. Most often, little or no damage takes place below the water level.

After installing T-anchors to support and reinforce the dual lining, material installation took place despite very limited clearance. The contractor accomplished this by stationing an applicator on a cart that wheeled along the bottom surface of the conduit. The project was completed with no interruption to traffic.

Membrane/monolithic sewer repair isn't as popular today as alternate technologies—thinner materials have emerged, which usually exhibit a lower surface permeability, as well as lower installation cost. However, some specifications continue to remain viable due to the structural advantages of gunited refractories.

Sliplining and pipejacking

Sliplining and pipejacking technologies are another form of restoration and corrosion protection that can be considered for sewer lines. Sliplining is a trenchless method of installing new factory-manufactured materials inside existing sewer, water and commercial lines. During the sliplining process, a winch cable is inserted through the existing line and then attached to the front of a resin-impregnated fabric sock or folded plastic tube that will become the new liner. The new liner is then pulled into the existing pipe and reconnected to the system. The sliplined insert is then pressurized and inflated with warm air or water so it expands to its ultimate diameter inside the old pipe.

Pipejacking, on the other hand, is primarily used for new sewer construction; although, restoration projects have been completed as well. It's a specialized tunneling process, usually with more surface disruption at the pipe entry points, or thrust pits. The methodology involves powerful hydraulic jacks that push the new pipe into place behind a boring shield.

Both of these methods of installing a new "pipe within a pipe" result in low permeance, thus rendering the line resistant to chemicals. This technology is quite effective in sewer laterals, especially those of a small to moderate diameter, usually less than 4 ft. These techniques can often be performed rapidly, without disturbing adjacent services or requiring bypass pumping.

However, sliplining and pipejacking applications beyond 2 to 3 ft in diameter often become prohibitive due to cost. The combined costs of material and application escalate as the internal dimensions of a pipe increase.

Epoxy lining

Many polymer linings are used today to serve as protective barriers for wastewater infrastructure. One of the most widely used is epoxy; although, other alternatives include polyurea, polyurethane and their hybrids.

The Middlesex County Utilities Authority (MCUA) in New Brunswick, N.J., is no stranger to the effects of microbiologically influenced corrosion (MIC). In February 2004, MCUA concluded that a 2,200-ft-long section of a concrete wastewater trunk line 7 ft in diameter would need rehabilitation.

During routine maintenance, it was discovered that one-half to two-thirds of the pipe had deteriorated from the acid attack generated by MIC. Middlesex could not risk losing the pipeline. This section of pipe would have to be restored or replaced.

MCUA anticipated a challenging project. The pipe was located 20 ft below ground. It had very limited access, with only three manholes for entry and exit, including one on each end and one in the middle. In addition, the pipeline was located more than a mile from the nearest road and also very close to the Raritan River, which introduced the potential for periodic jobsite flooding.

Middlesex County chose Jacobs-BBL as the project engineer. They concluded that excavation and complete replacement was too costly and posed potential complications given the layout and locale. The engineers also determined that pipejacking or sliplining would be problematic, as well as costly.

Jacobs-BBL found that Sauereisen, Inc. could provide products to both restore the concrete pipe and protect it long-term from further corrosive attack. The company chose the Sauereisen F-120 Series Underlayment to restore the concrete and specified 125 mils of SewerGard No. 210 Epoxy for corrosion protection.

More damage than expected

After gaining full access to the pipeline and commencing the ultra-high pressure water blasting phase of the surface preparation, Swerp, Inc., the general contractor, discovered the damage was much more extensive than originally anticipated. More than 4 in. of deteriorated concrete required removal. In addition, much of the reinforcing material was damaged beyond repair. However, a contingency such as this had been allowed for, and the required work was approved.

Swerp had initially planned to apply the restoration mortar via a small concrete pump, but with the drastic increase in the scope of work, this would not have been practical or economical. Fortunately, Swerp's experience and the versatility of the Sauereisen products provided a solution. The F-120 Underlayment is also manufactured in a gunite form, designed specifically for rapid application of large amounts of material.

The gunite application was approved and Swerp brought in a subcontractor, East Coast Gunite, with experience in this type of application. East Coast installed anchors and reinforcement where required and gunited more than 300,000 lb of F-120 in thickness up to 4 in. or more. This phase was completed in approximately three weeks, effectively restoring the integrity of the pipeline and providing a uniform substrate for the application of the epoxy corrosion-resistant barrier.

As each area of the gunite application of F-120 was completed, it was given a broom finish. This provided a mechanical profile to bond the epoxy topcoat, which was spray applied by Swerp after the underlayment work was completed. WWD

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