By Mike Oriol

PREVENTING PROBLEMS with Liners

Go full circle for complete pipeline protection

It's an old story: An aging wastewater pipeline ruptures, generating headlines and dumping millions of gallons of raw sewage into the Hudson River, the Schuylkill, the shores of the Great Lakes or elsewhere.

Such stories are far less common than they could be considering there are nearly 1.2 million miles of sewer lines in the U.S., some of which are more than a century old. Much of the credit can be attributed to the engineered lining and coating systems that began to appear in the mid-20th century and have been standard in the wastewater industry since the mid-1980s. With an appropriate lining or coating, the lifetime of most wastewater pipelines could extend virtually indefinitely.

The overwhelming majority of large wastewater pipelines today—both factory-fabricated and cast-in-place—are made with T-Lock liner, an extruded PVC sheeting that locks mechanically into the interior wall of a concrete sewer pipe with closely spaced locking extensions or ribs that have a T-shaped profile.

Another lining option is GSE StudLiner, a high-density polyethylene (HDPE) embedment liner that uses extruded studs rather than ribs for anchor points. Either of these systems can potentially give 50 or more years of service.

No Inspection, No Protection

With a lining in place, there is a temptation to assume your pipeline is well protected; however, no lining system works effectively unless the craftsmanship is good, and these technologies demand a high level of skill and care. In practice, a significant percentage of large, seemingly well-maintained pipelines may still be exposed to corrosion damage. Even with a lining in place, catastrophic failures still can occur.

Installer experience, specifications and site conditions can vary, and manufacturers acknowledge these issues. Ameron explicitly disclaims responsibility for the adequacy of the installation or damages related to the use of its linings, and GSE "strongly recommends" using only their own trained and credentialed installers.

In general, the problems that arise during installation fall into a few familiar categories. Most T-Lock failures occur at joints, where a joint strip and weld strip are heat-welded in place to connect the pipe sections. If the termination edges are not lined up precisely parallel and completely covered with the joint seal, an irregular corner can form, which will eventually begin to delaminate under the pressure of flowing water. The exposed corner starts to catch the flow like an underwater sail, and the lining starts to delaminate continuously and pull away. Exposure to the vapor space can allow hydrogen sulfide to reach the concrete with predictable and possibly catastrophic results.

This was the case with a recent V&A project in a Bay Area city. Shards of PVC had started showing up on the bar screens at the city's treatment plant. Investigation showed these were due to joint strip failures, which had begun to fail over a two-mile span of 66-in.-diameter reinforced concrete pipeline that had been installed with a T-Lock liner approximately 10 years earlier. Sufficient care and thorough inspection during installation could have prevented this.

Rushing the work can be an open invitation for an eventual pipeline failure. Ameron's field manual, for example, states that even an experienced craftsman should not expect to weld

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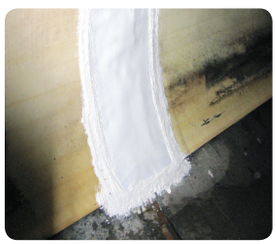
much more than 8 in. per minute. Inspection should include both visual inspection and pull testing using a calibrated scale in order to confirm that the adhesive is completely cured and to provide assurance that the liner is adhering to the adhesive and the adhesive is adhering to the substrate.

The StudLiner products use a less demanding fusion-welding joint technology, but inspection is still essential.



LEFT: Delamination of lower T-Lock liner extends 3-in. plus beneath termination line.

INSET: Close-up view of same area, showing corroded concrete and exposed aggregate.

RIGHT TOP: Delaminated (failed) joint strip in a 270-degree-lined pipe.

RIGHT BOTTOM: Completed repairs.

A thorough inspection will include shear strength tests on trial welds as well as vacuum box testing or spark testing for defects and possible leaks.

The quality of work should be a primary concern. In past years, when these products were being introduced to the market, very few contractors knew how to install them but did high-quality work. As often happens, quality standards tended to fall as the system began to gain wide popularity, and installers of varying skill and responsibility came into the industry. Some owners or installers may try to save time and labor by skimping on inspection, but that is a decision someone may deeply regret 10 years down the line.

How Much Lining?

In another rapidly developing area, the local sanitary district constructed a large concrete gravity sewer main with diameters up to 84 in. and a capacity of 44 million gal per day (mgd). Assuming that growing demand would keep the line at least one-third full at all times, the designers specified that only the upper 270 degrees of the pipeline required protection. This portion of the circumference was provided with PVC lining.

In the following years, the pace of development proved to be far lower than expected, and the anticipated flow rate did not materialize. During some periods, flow averaged as little as 7 mgd. This placed the flow line below the termination of the PVC liner and exposed the bare concrete to biogenic sulfide corrosion. The facility happened to extend through an ecologically sensitive area whose natural beauty was an important part of the local economy.

A condition assessment by V&A revealed extensive delamination in the lower section of the liner as well as damage to the reinforced concrete. The timing was fortunate in this case; while it would have taken very little further damage to cause a major wastewater leak with substantial environmental and economic damage, the condition was discovered prior to failure and rehabilitation.

Because internal corrosion typically only occurs on nonsubmerged surfaces, design engineers will not include liners on wastewater pipelines that are expected to flow at full capacity. Another sanitary district in northern California had a 48-in. reinforced concrete pipeline that was intended and designed to be operated continuously full of wastewater. As in the first example, an air gap was created in the pipeline due to changes in the operating conditions. In this case, the result was a type of corrosion known as crown cutting. The topmost area of the interior pipe surface became exposed to hydrogen sulfide (H_2S) gas and within two years of H_2S exposure, a large area of concrete had visibly deteriorated.

The Bottom Line

Owners are often tempted—primarily for economic reasons—to use liners only on the area exposed to air or elect not to use an interior surface liner. V&A discourages this approach and recommends that all wastewater pipes be provided with a corrosion-resistant liner or coating. Measured against the cost of a future pipeline failure, a 360-degree lining should be regarded as an affordable form of insurance. WWD

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