WATER ENVIRONMENT & TECHNOLOGY

Lateral Packers, Grout Close in on Infiltration

Application added to maintenance programs

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Over the past 20 years, tremendous progress has been made in reducing infiltration of groundwater into sewer systems. Now, one of the last sources of leaks is being sealed.

Wastewater professionals always have been concerned with infiltration and inflow (I/I), but money, knowledge and technology were not available to combat the problem until the late 1970s. The Clean Water Act of 1972 provided funding to build and expand wastewater treatment plants, and required utilities to determine whether their collection systems were subject to extraneous flow. Subsequent studies showed that infiltration and inflow have to be reduced to protect treatment plants from the overflows and inefficiencies caused by flooding during wet seasons and rain events. As awareness of collection system needs grew, knowledge and technology developed to meet them. For example, chemical grout, developed in the 1950s, was used to stop pipe joint leaks. Ten years later, techniques to slip new polyethylene pipe inside existing lines were developed. Cured-in-place pipe followed in the '70s, and introduced a period of rapid growth for trenchless technologies that stopped leaks and added structural integrity to deteriorating pipelines.

TRB SPECIALTY REHABILITATION INC.

The tapered lateral tube prevents grout from blocking the line while pressure from the packer forces grout through cracks and other openings at the connection and in the first few feet of the line.

Still, with all these tools at hand, visual inspections and flow studies showed that pipeline rehabilitation did not always result in the I/I reduction projected by sewer system evaluation surveys. One theory for the continued presence of infiltration was that a portion of the infiltration originated from the lateral and a second portion migrated to the lateral connnections.

In 1980, the Washington

Suburban Sanitary Commission (WSSC) in the District of Columbia reviewed its leaking laterals and found thimble break-in connections to be major contributors to the leaking connections. Excavations revealed common problems such as irregular break-in openings, missing or deteriorated jute in the gasket areas, and a lack of concrete or mortar encasements.

Working with an equipment manufacturer and a service company, the commission sought a cost-effective repair solution for its 275,000 service connections. The team invested time, money, and energy toward product development. Trent Ralston, president of TRB Specialty Rehabilitation Inc. of Gambrills, Md., came onboard to help further refine the packer. This enabled the group to produce one of the first lateral packers that tests and seals lateral connections. The packer also will seal several feet of the lateral line with grout, if necessary.

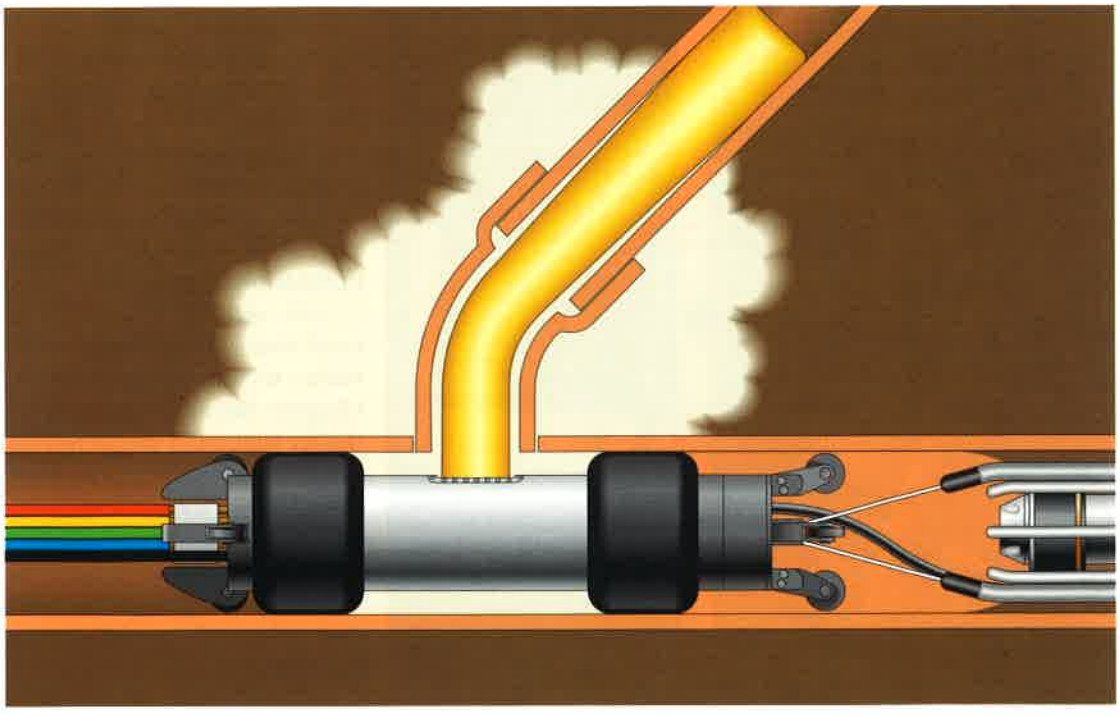
While several brands of lateral packers are on the market today, they have similar basic appearances and operations. Like mainline packers, lateral packers have inflatable ends to isolate a section of the main line for pressurizing. But, the center section of a lateral packer can rotate, and it contains an inflatable tube with an enlarged end that can extend into a line and form a seal.

In application, a remote-controlled video camera tows the packer through the main line. When the packer is centered on a lateral line, the ends are inflated and the center section aligned with the lateral. The tube is then propelled into the lateral and inflated. The void created by the three end seals is pressurized. If the pipe holds the pressure for a prescribed time period, the connection requires no grouting, but if the lateral and the connection do not hold the pressure, chemical grout is injected through the device.

This relatively simple method of sealing leaks has been accepted by wastewater operations, such as Miami-Dade. "We didn't realize how much groundwater was coming in through the lateral connections until the pan and tilt camera was developed," says Rod Lovett, chief of the Miami-Dade Water & Sewer collection division in Miami Beach, Fla. "There's a lot of stress on lateral connections and that's where you generally get a crack. If a pipe has been lined, you'll still have the leaks at the lateral connection, plus groundwater will migrate through the annular space between the two pipes and come in the lateral opening."

Now, Miami-Dade requires all lining contractors to seal each lateral connection.

The grout fills the annular space between the lateral tube and the house lateral pipe, and is forced into the surrounding soil through leaking joints, cracks, or other defects in the connection and the line. After the grout gels (in a minute or less), the air pressure in the void is released, then reapplied to test the seal. If the void does not hold the pressure, the grout injection is repeated. This process continues until the lateral pipe and connection are sealed or until the engineer's field representative and the operator determine that the grout consumption is too high and may block the lateral pipe.

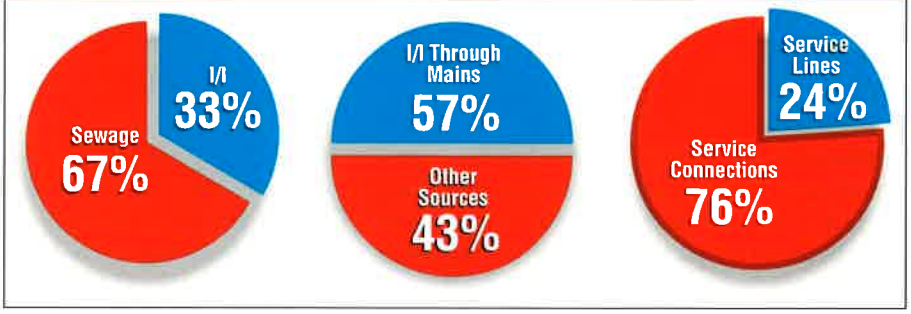


Air pressure forces chemical grout into the annular space around the inflatable tube, out through cracks, and into the surrounding soil. The gelled grout forms a waterproof seal.

Lateral Sealing Warranty Testing

Laterals tested or sealed	Laterals sealed only	Air test (psi)	Age of grouted laterals (years)	Number of warranty tested laterals	Number passing air test
178	107	6-9	1-2	7	7
85	51	6-9	1-2	3	3
76	46	6-9	1-2	3	3
90	54	7-10	1-2	4	4
1,900	1,140	8-12	2	69	69
1,927	1,156	8-12	1	58	58
1,773	1,064	8-12	3-4	67	67

Inflow and Infiltration



In 1976, WSSC found that one-third of its flow was caused by I/I (from left); in 1991, Nashville, Tenn., found that lining mains stopped about 57% of its I/I; and in 1980, WSSC determined that 76% of I/I in lateral lines entered near connections to the main.

After the test and seal operations, the operator withdraws the lateral tube and injects air pressure into the lateral line. If pressure does not build, the line is clear. The end seals of the packer are deflated, and the packer and camera are repositioned to allow an unobstructed view of the connection. At that point, the operator requests a water flush from the homeowner to verify that the lateral is open.

In less than 1% of operations, the lateral line will be blocked by chemical grout that escapes around the end of the lateral tube. The blockage usually can be broken loose with a high pressure blast of water, or a snake in the line.

In 1988, WSSC managers determined that leaks in their system cost $3.04 per gallon (calculated through a 20-year present worth analysis) for transportation and treatment of groundwater. That made the break-even cost for a 1,000 gpd leak $3,040. Typical point repairs involving excavation cost between $3,500 and $6,000. The cost of sealing laterals with chemical grout ranged from $500 to $650 per connection engaged.

Since its inception in the early 1980s, the lateral packer program cost has been more than $2.2 million, but WSSC eliminated 1.7 mgd of infiltration. The average cost was $1.33 per gallon. WSSC managers estimate they saved about $5 million in transportation and treatment costs.

Periodic tests have shown that connections sealed with chemical grout hold up well (See Table, *Lateral Sealing Warranty Testing*).

Philip M. Hannan, WSSC maintenance reconstruction division head, reports that the lateral connection grouting program has been successful and will continue in the future. Hannan points out that grout is not a cure-all, but a cost-effective tool to use in an infiltration reduction program.

"I believe there's more than ample evidence in the industry that the chemical grouts available do indeed stop leaks," Hannan says. "It is a non-structural repair, but the material, properly applied, certainly will eliminate leakage at joints and connections very cost-effectively. It's one of the few rehabilitation technologies available which will give you a payback, over time, for even small leaks. Many technologies are simply too expensive to be cost-effective unless you have a large leak.

"I think most people would agree that grout is not permanent in the sense of being able to stipulate a 50-year life," he continues. "But you can do a series of economic evaluations, based on the cost of grout and its life cycle, which will show that it is more economical than other technologies, even if you have to refresh the grout seal several times."

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