50th Anniversary of CIPP
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Nashville, TN
Keynote: Richard Thomasson

The Washington Suburban Sanitary Commission (WSSC) was formed in 1918 to handle water, sewer and stormwater responsibilities in Montgomery and Prince George's counties in Maryland. When the WSSC was formed and took over several local sewer systems were comprised of single-strength terra cotta pipe.

In 1978, the sewer system was over 50 years old and more than 800 miles were 30 years old. A large number of maintenance problems were occurring, and maintenance costs were also increasing. WSSC was always a progressive agency and was on the cutting edge of the technology and seen as being in the forefront of changes in the water and sewer industry. At this time WSSC was the 7th largest water and wastewater utility in the US.

A proactive program was developed to inspect, clean and repair the aging sewer system. The sewer repair program involved grouting for I&I removal and excavation to repair the damaged sewer lines. WSSC was actively investigating alternatives to the excavation and replacement of the sewer lines.

Sliplining was the only other alternative to complete replacement of the sewer in 1978, for the rehabilitation of the sewer lines. The backlog of work was constantly building because of the budget constraints and resources on the maintenance work force.

In 1978, WSSC was approached by Insituform East, Inc., concerning a new sewer restoration method which had been used in Europe since 1971. The process was Cured In Place Pipe (CIPP). Insituform was the name for CIPP at that time and was described as the insertion of an impermeable, corrosion-resistant lining inside existing sewer mains. Art Lang was the CEO of Insituform East, Inc. who brought the process to Richard Hocevar, Deputy General Manager for WSSC.

A pilot project for EPA was handled by Tom Driver in Illinois. Also, initial introduction to Insituform was on the West Coast in 1977, but the focus was mostly on the manufacturing process and less attention on the technical aspects of installation. After thorough review of all available data on the process, WSSC agreed to use Insituform to reconstruct some of the deteriorated sewers.

A brief summary of the process was the use of a flexible tube with one or more layers of polyester felt bonded to a polyurethane membrane, which retains the resin that saturates the felt prior to installation. The polyurethane membrane becomes the inside wearing surface when the felt tube is turned inside out during installation. The cure system is a polyester based isothalic resin incorporating a three-component peroxide initiator.

The properties of the felt/resin layer after cure were the following:

Property	Value (min.)	ASTM Test
Tensile strength at yield	4000 psi	D638
Ultimate elongation at yield	2%	D638
Modulus of elasticity	150,000 psi	D638
Flexural strength	8,000 psi	D790
Flexural modulus	150,000 psi	D790
Shear strength	6,000 psi	D732
Impact strength	2 in.-lbs	D1709
Barcol harddness	35	

As you can tell, there were only a few parameters to check to be sure the CIPP lining was acceptable from a design standpoint. Other critical parameters were the exact size of the sewer and the determination of the height of the water column necessary to move the tube through the sewer.

Think of all the additional design advancement that has taken place during the years since 1978. There has been so much research on ovality and other design considerations from the beginning 50 years ago. There was a historic session at NoDig with George McAlpine and Lynn Osborne presenting Insituform's view and an academic's view on ovality and its impact on design strength. As far as I am concerned, this was one of the most anticipated and informative sessions at NoDig, and I have been involved with all of them.

The installation process was described to customers, officials, and other stakeholders so they would be well-informed on the new process. The sewer is thoroughly cleaned to remove all roots, grease and debris. A closed-circuit television is used to inspect the sewer for cleanliness and to locate all house connections.

The flexible liner is cut for the desired length (manhole to manhole plus height to top of inversion tube) and the felt portion of the liner is saturated with the catalyzed resin. The stretch of sewer to be Insituformed is isolated from the system by plugging the section of pipe and pumping upstream sewage around the project area through a temporary line above ground (by-pass pumping). Water services to houses discharging into the affected stretch of sewer are cut off so no flow can enter while the liner is being installed. Access through existing manholes is used to install the liner.

Water pressure from static head of a column of water is used to expand the tube, and move it into proper placement, firmly against the inside surface of the old pipe. After placement, the water in the liner is circulated through a boiler to reach a prescribed cure temperature of 160 degrees and discharged into the pipe via a lay-flat tube. When the cure cycle is complete, the liner has become rigid and is, in essence a new pipe. Each end of the rigid tube is cut off flush with the manhole walls to complete the process.

In the first three years, improvements in the cure system reduced the cure temperature by 20 degrees and cure time from around 5 hours to 3 hours. These changes resulted in energy savings, plus a reduction in total installation time. Improvement in the Insitucutter resulted in better service re-instatement and less inconvenience to residents.

Service restoration was the next step to complete the restoration of service to any residents which had been isolated by the installation of the CIPP liner. A closed-circuit television unit with a special cutting unit (Insitucutter) is pulled through the newly installed liner. The footage to each house service was previously recorded so the cutter can be positioned. In addition, the water pressure causes the liner to dimple into the house service slightly so visual confirmation of the location of the house service can be made on the TV monitor.

The Insitucutter is used to make precision cut in the liner to fit the diameter of the existing service connection. After the opening of the service connection to the newly lined sewer, the water service is turned on, restoring full service to the homeowner. This original method was fraught with problems associated with operator error and proper location of the sewer service.

The initial sewer line chosen to use the Insituform process for reconstruction was one of many lines which could not be replaced by open excavation because of environmental (stream), traffic (State Road) and a railway. The reason for selection of the line was to see if the process could reconstruct the worst situation in the massive backlog of sewer problem lines.

Choosing this line indicates WSSC had ultimate confidence in the process, or we were just a little out of our minds.

The sewer line was a 200-foot 15-inch line which travelled under four-lane Route 1, a 25-foot stream and the AMTRACK and B&O rail lines. The sewer line was reinforced concrete pipe and had a slope of 0.8. The location was near 11270 Baltimore Boulevard in Beltsville, MD.

The work was scheduled for October 31, 1978. Not intentionally, but possible rational for this date was it being a fright night for all involved. If there was not enough pressure on me for success of the process, Richard Hocevar (Deputy General Manager), James Lee (Maintenance Director), Arthur Brigham (Public Affairs Officer) and Douglas Baker (Systems Maintenance Division Head) my immediate boss were on the job checking with me every half hour on what is happening and will everything be alright.

The location precluded the use of bypass pumping of the flow through the night. Septic tank pump trucks were used to pump out the manhole above the impacted sewer and hauled to a manhole below the affected stretch. The night was interesting from listening to the septic tank trucks back up alarms, which fit in well with the Halloween night atmosphere.

Because of the railroad, there were only remote ways to get to the downstream manhole. An additional critical component was the calculation of flows, tanker truck capacity and travel time from upstream manhole to downstream manhole and time to unload the tank truck. This was just only one aspect of working with Insituform to actually solve installation problems in the field.

Another was determining the height of the column needed to move the liner through the sewer main which had a low slope. On this first job, overcompensation was designed as no failure was acceptable and the liner was to be installed without problems. This resulted in requiring the liner to be restrained from too quickly being installed, which would push out the resin in a slug in

front of the liner and thinner resin in the felt liner. These were not design calculations, but field adjustments that were required to be made in the field with engineering judgment. WSSC construction and maintenance experience allowed us to make adjustments in response to the situation.

A second sewer in the backlog was lined January 1, 1979. This sewer was in a right-of-way behind Mrs K's Toll House at 9201 Colesville Road. The sewer was 8 inches in diameter and 276 feet long, on a slope of 5.08. There were four services, including the restaurant and a dentist office. No work could be done with conventional excavation as the right-of way documents only indicated the pipe and taps were within the easement for WSSC.

We chose this date for the dentist being closed and started the work after the restaurant closed. In this case, by-pass pumping could be used and no back up alarms of septic tank trucks were heard. Since this was the first sewer connection reinstatement, there were problems with the Insitucutter, which resulted in impacts to the dentist office work on Jan. 2. Also, because of the small size, there were impacts on the installation of the liner. All of these problems were inherent in using something new and Insituform East worked with WSSC to plan for these types of situations on future work. In these early installations, there were also boiler problems which resulted in longer cure times.

WSSC continued to work with Insituform East on many new projects because of the cost savings, reduced environmental impacts and less customer disruption than conventional open-cut construction. A new program for reconstruction of sewers was developed in response to the use of CIPP lining.

You may have noticed that I have used the term reconstruction and not rehabilitation throughout this talk. In the WSSC budgeting process, we were advised that we could not use capital budgets for rehabilitation work. The term rehabilitation implied maintenance activity and it must come from operating funding. Most of you know that operating budgets are much less than capital budgets because of the bonding use for capital budgets.

Richard Hocevar, who was a master of thinking out of the box, asked legal to give an opinion on the use of the term reconstruction. WSSC bylaws, were specific that capital funding was to only be used for construction. Legal gave the opinion that since it had the word construction in it, that it could be budgeted as capital funding. The major reconstruction program commenced using CIPP and budgeted under capital funding.

As far as I was able to determine, WSSC was the first to reach 100 miles of CIPP lining. We also, for a short time, had the largest size sewer CIPP lined at 72 inches. WSSC also developed a standard methodology for trying new products for use in the reconstruction program.

I developed a comparison of costs for CIPP lining versus conventional construction used at WSSC to support the justification of budgets in the reconstruction program. For 248,00 feet of sewer 6 inches through 30 inches, the cost for CIPP was $13,389,707 versus $26,748,610 for conventional construction. This shows a saving of 50% due to the use of CIPP. These savings do not include monetary savings for disruption, environmental degradation or customer impacts.

I was privileged to meet Eric Wood the inventor of CIPP(Insituform), under very strange circumstances in 1980. I gave a paper on CIPP at the WPCF conference in Las Vegas. James Lee and his wife and Linda, my wife, and I had to leave our hotel a day early. Art Lang arranged for us to move to Eric Wood's room as he had to fly out and was to come back a day later. We moved to his room and both couples were laying in the beds watching tv. The door opened and Eric walked in and was startled to see two couples in the queen beds. We introduced ourselves and related the circumstances for our being there. He had forgotten something and came back to the room before flying out. He then remembered the arrangement that Art Lang had discussed with him. He was a brilliant individual but in the first moments when he entered the room, he was speechless and confused. I know I will never forget the meeting, he probably wanted to forget the occasion.