A Growing Problem:
Rehabilitating Aging Sewer Pipes

By Michele V. Brier

Milwaukee CIPP Sewer Rehab Project Successfully Tackles Challenges

While every sewer rehab project has its share of challenges, Milwaukee's recent sewer rehabilitation efforts truly shed light on a rapidly growing national problem: aging sewer pipes in densely populated areas and places in proximity to lakes and streams, a common source of drinking water.

Milwaukee's sewer rehabilitation efforts had every challenge imaginable: historic location, rivers, extreme weather, 90-degree turns, tight deadlines and more. These issues highlight what every city faces when rehabilitating its sewer system — its most valuable public asset.

The Facts

- The Environmental Protection Agency (EPA) estimates that as much as 860.5 billion gal of sewage are dumped every year into rivers and lakes nationwide.
- The United States has approximately 20,000 sewer systems, more than 750 of which are combined systems that were built before the 1950s.
- Many sewer pipes in densely populated cities were built more than a century ago and are exhibiting significant signs of decay through leaks, voids or overflow issues.
- The EPA is issuing consent decrees to many cities. These decrees mandate that cities must rehabilitate their sewer systems or be subject to fines or limited/no access to funds for other infrastructure projects.

Milwaukee's Most Valuable Public Asset

Milwaukee Metropolitan Sewerage District (MMSD) is responsible for providing sewage services to the City of Milwaukee and most of Milwaukee County. Wastewater from 28 local sewer systems flows into the District's system of collector sewers before it is treated or temporarily stored in 19.4 miles of tunnels at depths of up to 325 ft. Completed in 1993, this sophisticated tunnel system holds 405 million gal of wastewater until treatment plants can clean them of biological contaminants that cause disease and treat pollutants such as fertilizers and street runoff. The tunnel system was designed to comply with federal water quality standards by reducing the amount of untreated sewage that is discharged into local waterways, such as Lake Michigan, the city's source for drinking water.

"Our forefathers were smart — they took note of the geography, the three rivers and designed a pressure pipe system that leveraged the low and high levels," said Larry Ellis, senior project manager at MMSD. "Without cameras, levels and other equipment used by today's civil engineers, our forefathers simply worked with gravity, starting at a higher point and creating a siphon to carry wastewater through the pipe, which saves us money on pumping."

In 2003, it was discovered that some 14,000 ft of pressure sewers needed to be replaced or rehabilitated. A bid to replace the entire 14,000 ft of pipe was rejected. Budget and project location led to the decision to reline 10,000 ft of pipe and dig-and-replace the other 4,000 ft. The $12 million sewer rehabilitation project was spread out over three years. The first project — an interceptor sewer — was conducted in 2005.

The following year, the second project involving a stacked configuration began. A 60-in. circular cast iron pressure sewer was located above a 49-in. by 72-in. rectangular concrete box sewer gravity conduit. This arrangement created challenges in accessing the pipes.

While no obvious cracks existed, the cast iron was degrading and getting thinner.

Brownsville, Wis.,-based Michels Pipe Services, a leader in pipeline rehabilitation and a certified installer of the Premier-Pipe USA cured-in-place pipe lining process for sewer mains, was contracted to fix the problem.

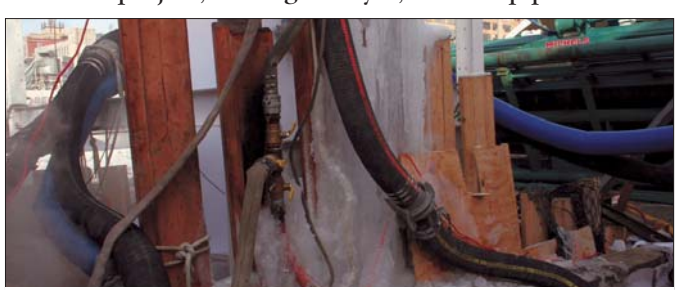
The third project began in November 2006 and involved a circular, cast iron 60-in. diameter pressure pipe located in Milwaukee's historic Third Ward, an affluent urban area. Because the area was designated historic, contractors adhered to stringent rules, such as obeying a moratorium on digging freshly paved streets and keeping streets open when working.

"If we had to rip up the old sewer pipes and put in new ones, we would have had even more problems than we did," said Patrick Murray, project administrator of Rust Harza, a joint venture of Earth Tech and MWH America.

Location, cost and timing led to the decision to choose the cured-in-place pipe (CIPP) process. Saving millions of dollars compared to dig-and-replace methods, the CIPP process effectively relines the original pipe to create a new pipe within the existing one — all without digging. This trenchless technology has become the preferred solution for both residential and commercial applications because it's fast, proven effective and causes minimal disruption.

"We also chose CIPP because we didn't want to give up capacity," said Ellis. "We wanted to keep the pipe as big as we could. We considered sliplining but realized that would make us lose some capacity, which we didn't want to give up."

Michels Pipe Services again handled the installation for this third project, relining nearly 4,000 lf of pipe in one of



Weather was a huge factor during the project. At times, trucks and other equipment rolled to the site covered in ice.

Frigid temperatures added to the challenge. Temperatures hit a record 15 F below zero, with a wind chill of 50 F below zero.

the busiest areas of Milwaukee. The project had a tight six-month window for completion, prior to SummerFest, Milwaukee's famous annual music festival.

Once the decision was made on the method of rehabilitation, Michels placed an order for the felt liner from Applied Felts, a worldwide leader of felt liner manufacturing and pioneer of the CIPP rehabilitation process. Applied Felts Premier-Pipe USA inversion tube was selected for its high-quality, ISO 9000 manufacturing requirements and flawless past performance record.

"We like Applied Felts products," said Shawn Thorson, project manager at Michels Pipe Services. "They're durable and easy to work with."

"The Applied Felts liner is structurally competent," said Murray. "For this project, we ordered a liner that was composed of seven layers of felt and 1.5 in. thick. What's great is that you design to different thicknesses, depending on what you are trying to accomplish — it's completely customized to your job specifications."

About CIPP

Michels Pipe Services used the Premier-Pipe water inversion method for CIPP rehabilitation. The basic process begins by taking the lead end of the Applied Felts resin-saturated liner and turning it inside out for a pre-determined length and clamping it to a collar over the manhole. Water is then introduced into the turned back section creating a head, which causes the lining to continue turning inside out along the defective pipe. The constant addition of water maintains the inversion head, inverting the liner and ensuring it is held firmly against the host pipe. When the installation is complete, the water in the liner is circulated through a mobile hot water boiler to gradually raise the water temperature to achieve a controlled cure of the resin. When the cure is complete, the end of the newly formed pipe is cut and trimmed.

Overcoming Obstacles

Gaining access to the pipe was one of the first challenges of the job. Because the pipe was a pressure pipe, manholes didn't exist. Therefore, three shafts — 12-ft by 15-ft holes — were made in the ground to access the pipe. Additionally, 20 to 30 million gal of sewage a day was diverted to the tunnel system, which eliminated the need to establish bypass pumping.

Other difficulties were the S-curves and 90-degree bends in the pipe. An epoxy coating was applied to the raw edges and the top and sides of the S-curves prior to relining.

Next, Michels constructed a 20-ft tower above the shaft to ensure the liner would correctly enter the existing pipe, which was 12 ft deep in the ground. This tower was needed to effectively force the liner into the existing pipe.

While every day on the job presented a new challenge, one thing was fairly constant — cold weather. Temperatures hit a record 15 F below zero with a wind chill of 50 F below zero. Trucks and other equipment often rolled to the work site covered in ice.

"The resin arrived from Minnesota in tankers in time for our first run. But by the time it reached us, it was only 40 F when it should have been at least 65 degrees in tankers in time for our first run, but by the time it reached us, it was only 40 degrees," said Thorson.

When resin is too cold, it thickens, making it difficult to pump into the felt bag. With constant freezing temperatures and cold resin, Thorson ordered a ground thawing unit (a hot water boiler in a trailer). The thawing unit was used to heat the truck with the resin, bringing the resin up to 65 F and enabling it to easily flow into the felt liner.

The Michels team worked long hours to prepare and install the liner correctly. Several men stood on the roller bed, which housed the dry felt liner, while others worked to ensure the resin was worked to the outer limits of the felt liner, evenly saturating it.

"Once you get over the hole and start feeding the liner into the pipe, you don't stop until it's completely done," said Thorson, describing how his crew stood on the 20-ft tower battling wind gusts flowing from the surrounding rivers. "Working on the high tower with the cold-biting winds was really difficult."

Record Runs

The first run was the longest and the hardest — nearly 2,000 ft with a 30-degree bend. The team began in the early morning hours of Feb. 13, working 24 hours a day in 12-hour shifts. The liner finally reached its destination inside the pipe five days later. The team then used the hot water curing method to secure the liner.

"That was one of the longest single pushes I've ever seen," said Murray. "It was amazing to watch the liner going into the ground from the high tower."

The second run was almost as long as the first and included a 90-degree bend. Michels handled the bend effectively by starting higher in the air to generate a bigger column of water during the inversion.

"It was crazy," said Thorson. "Nearly 4,000 ft of pipe done in two long runs in the dead of winter with ice freezing equipment and people continuing to walk around our work area since we couldn't close any roads."

"In all my years in this business, I've never seen a sewer rehab project with so many challenges in one job and with the longest, most successful runs I've ever witnessed," said Jim Mortell, president of Premier-Pipe USA. "The Michels project team remained calm and confident throughout the job, tackling every challenge professionally. It really represents the best over-the-hole projects."

Despite all the challenges, the project was a big success.

"What is truly remarkable about this project is that it could have been fraught with disaster, given all the challenges we faced," said Thorson. "Instead, we worked together to overcome all the challenges that came our way and in the end, we succeeded."

"Our sewer rehabilitation efforts really show how any challenge can be overcome with the right people and equipment," said Ellis. "That's the best advice I would offer any municipality preparing to rehabilitate their sewer system."

"This project was completed and won on the basis of sound engineering principals with competent personnel managing all the variables that come into play on any complicated and complex project of this nature," said Michels vice president Kelly Odell. "It helped that the Michels team has a combined expertise in CIPP installations of more than 250 years."

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Relining Aging Brick Sewer Pipes

On any given day, the streets of Portland, OR's Hollywood business district bustle with heavy traffic, people, big intersections and the energy of any popular city. That's why when the city of Portland discovered it needed to rehabilitate 3,000 feet of sewer pipe on Sandy Boulevard – one of the largest and busiest streets – significant effort was made in the planning phase to minimize disruption.

Long before many who today walk on these busy streets were born, the city's network of sewer pipes was established. Portland has more than 2,000 miles of pipe, some dating back to 1864 when many pipes were made of bricks. The limited lifespan and age of the pipes was showing through cracks, voids and other defects. Ongoing video and on-site inspections to monitor the pipes enabled the city to identify and evaluate the deterioration and proactively fix problems.

"It's always preferable to work on a planned project to fix a pipe sinkhole or collapse rather than an emergency situation such as a raw sewage spill on the street above," said Bob Cynkar, community outreach representative for the city of Portland Bureau of Environmental Services.

The decision to rehabilitate the majority of the 94-year old brick sewer pipes in the Hollywood district was made after routine inspections showed widespread cracks, holes, and in some cases, bricks falling out. Additionally, the city was planning a comprehensive street improvement project that included resurfacing, concrete work and changes to intersections.

"We were concerned about the conditions of the pipe upon routine inspections and we also wanted to get in and out of there before the city started its street project," said Cynkar.

With the budget at the forefront, Portland explored various options for rehabilitating the sewer pipes with the least amount of disturbance to the street above. Open trench excavation was ruled out because of the impact to the business district, working around other pipes, such as cable, water and gas, and the need to complete the job on a fast timetable. Given its proven success and speedy implementation, the CIPP (cured-in-place pipe) process was chosen. CIPP effectively relines the original pipe to create a new pipe within the existing pipe without digging. This trenchless method is popular for both residential and commercial applications because it's fast, proven effective and causes minimal disruption.

The $5.4 million project dubbed, "Hollywood Relief and Reconstruction Project" was awarded to general contractor RCI Parsons of Portland, OR, who sub-contracted the CIPP portion of the job to Salem, OR-based Michels Pipe Services, a certified installer of the Premier-Pipe USA Cured-In-Place Pipelining Process for Sewer Mains.

"We've had a lot of great experience with CIPP and were excited about this project because it presented some interesting challenges," said Ron Smisek, project manager, Michels Pipe Services.

Overcoming challenges

A significant challenge was working in a densely populated commercial area which included four lanes of traffic and six freeway ramps. In addition to the hectic daytime activity, the area is equally busy at night with evening-goers visiting restaurants, movies and other favorite nighttime spots. As a result, attention to detail during the planning phases of this project was vital. Silent generators and compact installation equipment was used to reduce disruptions on the street.

"The CIPP process was really the best choice for this busy area," said Nate Rodriguez, project superintendent at Michels. "This process enabled us to avoid digging up the road and really impacting traffic and areas businesses."

Another difficulty was relining a 43 by 45 inch brick pipe that was elliptical-shaped instead of circular. This uniquely-shaped pipe made it difficult to establish the bypass. After the first failed bypass, RCI Parsons decided to build a temporary weir to keep water away from the job site and ensure the success of the bypass. An 18-inch gap was left at the top of the pipe to effectively handle water overflow.

"When they built this pipe in the old days, it was probably easier to lay the brick like an arched doorway where the top of the pipe is round and the bottom part is concave, like a basket handle," said Smisek.

"Fortunately the materials we used for the project were custom-made with exact specifications, enabling us to overcome this challenge."

The materials included felt liners supplied by Applied Felts, a leading felt liner manufacturer and a pioneer of the CIPP rehabilitation process. Applied Felts provides ISO-9002 certified, custom-designed liners to meet clients' exact specifications, which for this project meant five, 600-foot liners, each weighing 80,000 pounds. The liner measured 42 by 45 inches by 34.5mm.

Before the liner could be installed, new manholes were created to accommodate the large liner. Five 96-inch manholes were built specifically to insert the liner into the existing pipe to create the like-new pipe.

Process

The pipes were lined by Michels Pipe Services using the Premier-Pipe water inversion method for CIPP rehabilitation. The basic process begins by taking the lead end of the Applied Felts resin-saturated liner and turning it inside out for a predetermined length and clamping it to a collar over the manhole. Water is then introduced into the turned back section creating a head, which causes the lining to continue turning inside out along the defective pipe. The constant addition of water maintains the inversion head, inverting the liner and ensuring it is held firmly against the host pipe. When the installation is complete, the water in the liner is circulated through a mobile hot water boiler to gradually raise the water temperature to achieve a controlled cure of the resin. Once the cure is complete, the end of the newly formed pipe is cut and trimmed.

Prior to relining the pipe, the team conducted patchwork, such as fixing voids and filling in bricks, as noted by video and onsite inspections. While the team was conducting these preparations, the wet-out process was started and completed in the evening.

Due to the large liner size and limited space (only one traffic lane) at the job site, the actual wet-out process was conducted at Michels' facilities in Salem. A 33-ton crane was used to pull the liner into a 15-yard dumpster that was set on a low-boy. The first wet-out took 16-18 hours with succeeding liners completed in less time. A special roller was built to accommodate the large liners and transport the liners on the low boy to the job site.

The crew began the install process by using a crane to pick-up 5 to 12 feet of the inverted liner and slowly place it into the existing pipe using the water inversion technique. The installation took anywhere from five to 8 hours per liner.

One 600-foot liner was repaired and relined each week enabling the CIPP portion of the project to be completed in just six weeks.

The entire project took six months and also included rehabilitating most of the collector sewer, about 40 square blocks, which feeds into the 3,000 feet of pipe.

"This was a true success story in how to rehabilitate an old sewer line while simultaneously keeping an incredibly busy commercial area fully operational," said Jim Mortell, president of Premier-Pipe USA.

"We wanted to rehabilitate our sewer in some cost-effective way that would give us a good result and we did that," said Cynkar. "Lining pipe is attractive when you don't want to tear up the street, railroad or freeway. As more and more of the world is developed, you not only see more infrastructure on the surface, but underground so it's harder to dig a hole without causing problems."

FOR MORE INFORMATION:
Felt liners:
Applied Felts, (203) 426-5948, appliedfelts.com
Contractors:
Michels Pipe Services, (503) 364-1199, michels.us
RCI Parsons, (503) 287-5742
CIPP system:
Premier-Pipe USA, (952) 944-8093, premierpipeusa.com

MaxLiner Introduces New MaxTrailer

MaxLiner unveils the MaxTrailer, an all-in-one mobile cured-in-place-pipeline (CIPP) unit that adheres to ASTM F-1216 for lateral lining in February.

"We're making it even easier for contractors to continue to succeed in the 3-10 inch lateral pipeline market," said Gil Carroll, MaxLiner's director of business development. "By putting our entire MaxLiner system, as well as some other specialized equipment, into a custom designed, technologically-advanced trailer, we're helping contractors improve productivity, enhance quality control, save money and ultimately grow their business."

The 15 foot by 6.5 foot MaxTrailer easily attaches to any service vehicle and comes fully-equipped with everything a contractor needs for a CIPP rehabilitation project, such as vacuum for the liners and inline 100 percent solids epoxy resin mixers, with the highest level of quality available.

Other features include: computer-controlled epoxy resin mixing system; inversion and heat-cure installation equipment built into the trailer; high-tech equipment to control all aspects of the CIPP process; a complete mobile impregnation facility with tanks; computer-controlled mixing system; QA/QC generated reports; and much more.

"We've eliminated all the time-consuming steps of setting-up the system upon arriving at the job site," said Carroll. "With the new trailer, contractors can pull up to the jobsite, open the door and go to work with all the equipment they need on one trailer." (276) 656-1225, maxlinerusa.com