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.

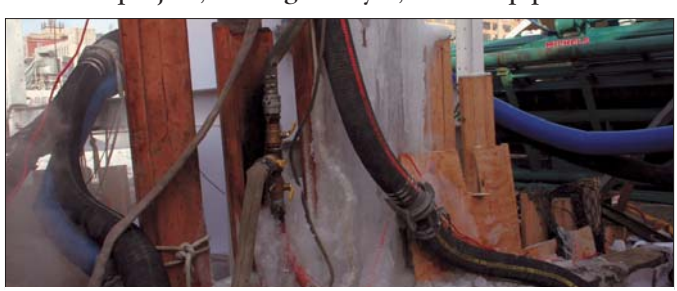
The third project began in November 2006 and involved a circular, cast iron 60-in. diameter pressure pipe located in Milwaukee's historic Third Ward, an affluent urban area. Because the area was designated historic, contractors adhered to stringent rules, such as obeying a moratorium on digging freshly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

Michele V. Brier is a freelance writer and owner of a marketing communications and public relations consulting business. She frequently writes about the trenchless technology industry.