Evolution of Cured-in-Place Pipe Allows Structural Renewal of Transmission and Water Mains

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The History of Cured-in-Place Pipe (CIPP)

In 1971, in the London Borough of Hackney, Eric Wood came up with a solution to repair a leaking pipe without replacing it. The concept involved installing a continuous, flexible felt tube saturated with a thermosetting resin, expanding it against the host pipe and allowing it to cure. Wood named his invention *insit u form* (Latin for "form in place"), which became known commercially as the cured-in-place pipe (CIPP) process. Today, CIPP is the most commonly used trenchless technology worldwide, with millions of feet of CIPP installed on an annual basis.

In 1977, Wood was granted a US patent for his CIPP process, which was commercialized domestically by Insituform Technologies until it entered the public domain in 1994. Expiration of patents led to increased competition and widespread use. With that came an increased emphasis on installation efficiencies, alternative installation methods, materials and equipment. Polyesters became the most widely used resins for domestic sewage applications as they offered good chemical resistance at a low cost. Vinyl esters and epoxy resins were utilized to a lesser extent in more aggressive environments and for low-pressure applications. UV cure technology and mobile, automated epoxy CIPP systems that were prevalent in Europe were introduced into the US market in the early 2000s.

CIPP's flexibility in design, installation, and range of application make it a popular solution for pipeline renewal. Gravity flow applications make up the majority of the market share, with sanitary sewers, service laterals, storm drains and culverts as the predominant end use applications. 3" to 120" diameter installations in continuous lengths over 2000 lineal feet are documented. CIPP can accommodate circular and non-circular shapes, directional changes, size changes, offsets and other geometric challenges that make it a popular choice over competing technologies.

Pressure Pipe Evolution

A natural evolution for the CIPP solution was to design a product that could withstand internal pressures and external loads for pressure pipe in wastewater and drinking water applications. Key objectives for the development included design of reinforced liners that could be manufactured in various diameters and thicknesses to meet specific pipe sizes and operating requirements. Resin systems must provide strength, chemical resistance and handling characteristics for the intended installation and operation. The composite CIPP solution would need to meet the criteria of NSF/ANSI Standard 61 for use in potable water.

Today, pressure pipe CIPP technology is available as a semi-structural (AWWA Class III) or fully structural (AWWA Class IV) solution for sewer force mains, raw water lines, industrial process lines, gas, fire protection and potable water pipelines. The range of application is generally 6" to 48" diameter at operating pressures up to 200 psi. An engineered CIPP composite system consisting of a fiberglass reinforced liner with a vinyl ester or epoxy resin is recommended for pressure applications because of their excellent tensile properties.

CIPP was introduced into the potable water market in North America in the early 2000s. Lining systems used for these applications meet NSF/ANSI Standard 61 and consist of fiberglass-reinforced liners and epoxy resins engineered specifically for each application. This is an emerging market worldwide with the fiscal need well exceeding available funding.

RS Technik has been an industry leader and global provider of epoxy CIPP solutions and mobile CIPP technology since 1994. Through its worldwide network of installers and global alliance with The Dow Chemical Company, RS Technik offers a wide range of CIPP solutions for sectional pipe repairs, service laterals, sewer mains, storm sewers, culverts, force mains, and potable and non-potable pressure lines for 4" to 48" diameter applications.

RS CityLiner® is a CIPP solution for gravity flow sewers up to 48" diameter. It consists of a felt liner and epoxy resin that is inverted in place using water or air pressure and cured with hot water or controlled steam. As an epoxy CIPP system, RS CityLiner is VOC and styrene free and designed and installed in accordance with ASTM F1216 for a 50-year service life.

Structural Renewal of Water Lines

Communities face two major growing issues:

1. Insufficient funding for water infrastructure improvements
2. Availability of clean water for public use

The Environmental Protection Agency (EPA) estimates a $335 billion shortfall exists for US drinking water infrastructure funding; a funding gap that could easily reach $500 billion by 2020. This is further reinforced by the 2004 study conducted by the American Water Works Association (AWWA) which concluded that only about 1% of the approximately 863,000 miles of water lines in service throughout the US were renovated or replaced, and that in 2050 the *average* age of water lines in the US will be 50 years!

Leaks and breaks in distribution and transmission pipelines contribute to 20-40% loss of treated water before it ever reaches the consumer. Billions of dollars are lost with over 7,000,000,000 gallons of water lost each day!

In 2010, RS Technik released its solution for structural water main renewal throughout Europe, RS BlueLine®. In May 2012, RS BlueLine was certified to NSF/ANSI Standard 61 by NSF International and made available for use throughout the Americas.

For pressure applications up to 48" diameter, RS BlueLine is the perfect solution. Available as an AWWA Class III or IV liner, RS BlueLine can be designed for an internal working pressure of up to 200 psi. RS BlueLine may be pulled in place (ASTM F1743) or inverted into the host pipe (ASTM F1216) and can be cured with hot water or controlled steam. For many years, RS BlueLine has been used to renew force mains, fire lines, raw water and potable water lines all over the world.

RS Technik's mobile saturation units are utilized by licensed RS Technik installers on every RS CityLiner and RS BlueLine project. These units offer distinct logistical advantages by eliminating the need for a fixed wet out facility, minimizing overhead and maximizing efficiencies. In addition, the computer-controlled, automated systems on all RS Technik mobile saturation units assure the highest level of quality and repeatability on every installation.

Using CIPP technology, damaged, deteriorated and encrusted pipes are cleaned and televised, then reinforced composite liners using The Dow Chemical Company's custom formulated resins are inserted into the existing pipe. Once inserted, hot water or controlled steam is circulated inside the lined pipe, curing the composite liner to restore system capacity, renew structural integrity and extend the design service life of the existing infrastructure.

In the United States, RS Technik and Dow have aligned with Inland Pipe Rehabilitation (IPR), the nation's largest trenchless solutions provider offering reliable and experienced CIPP installation services. Collectively, RS Technik, Dow and IPR offer a comprehensive solution for drinking water pipe that will stop leaks and structurally renew deteriorated pipe while minimizing disruption to people, businesses, adjacent utilities and infrastructure through trenchless technology.

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