

Renovating pressure pipes using the CIPP process



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The cured-in-place pipe process has been used since the early 1970s to renovate deteriorated pipelines. The process was first developed for gravity pipelines and has found some limited applications in renovating pressure pipelines.

CURRENTLY OVER 12 million ft (3.9 million meters) of pipelines are being renovated annually in North America using the cured-in-place pipe (CIPP) process. Many more pipelines around the world are being renovated using this process.

Designing the liner to be cost effective is a key component utilising this process successfully. The liner must perform as a new pipe and last a defined amount of time.

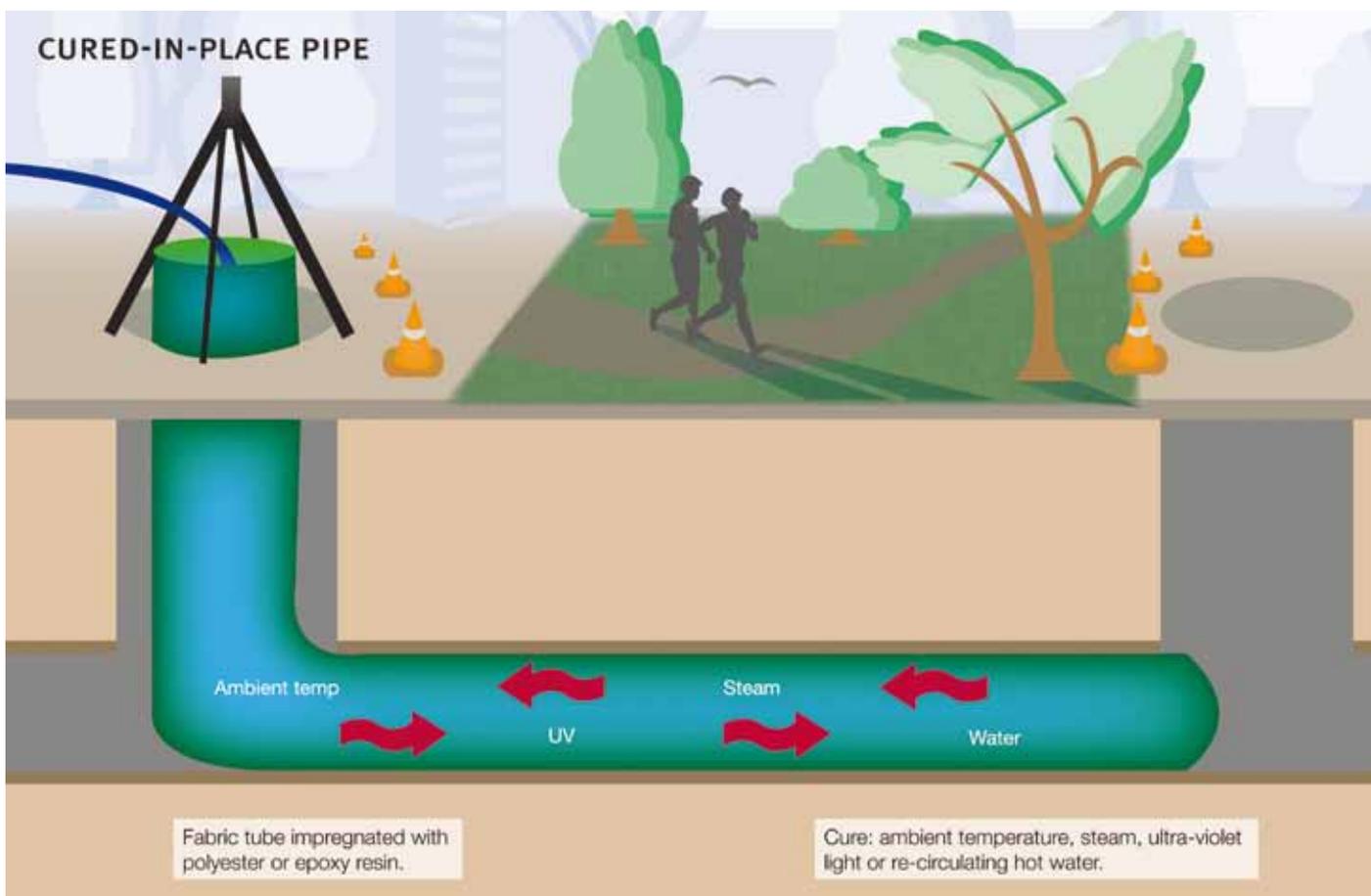
In gravity pipes, liner failure is generally due to buckling. The liner simply cannot support the loads to which it is exposed. The design of these liners takes those loads into account. The design equations consider the loads, hydraulic, soil and any dynamic loads. The equations basically consider flexural properties in the design of

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a gravity pipe CIPP liner. Tensile properties are only considered for the inversion or pull in place forces that may be exerted on a liner prior to final liner installation.

The stiffness (flexural modulus) of the liner is dependent on the resin used as well as the construction protocol. The felt bag contributes nothing to the ultimate physical properties of the constructed liner. It acts primarily as a carrier for the resin.

For several years there have been limited applications utilising the CIPP process to renovate pressure pipelines. Some of the most common pipelines being renovated include force mains, gas transmission lines and a small number of drinking water lines. Limitations in products available and dependable processing methods have to date limited using CIPP for renovating pressure lines. Many of those limitations are



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being addressed or have been addressed and the future of CIPP in that market looks promising. Estimates for the number of linear feet of pressure pipelines that need renovation exceed the number of feet of gravity pipelines that need renovation.

Renovating pressure pipelines

Renovating a pressure pipeline is a very different operation. A new set of physical property concerns as well as new construction methods must now be considered.

In gravity lines, buckling concerns determine the design equations. In pressure lines, tensile properties become important. Liner failure is generally due to internal tensile forces. The thermoset resins alone in a felt liner are generally not capable of satisfying the mechanical property needs of most pressure lines. With this in mind, liner engineering becomes important. The liners constructed for the CIPP process for pressure pipes are either liners constructed entirely of reinforcement media or that contain reinforcing media. This media may be fiberglass, aramid fibers, or carbon fibers, or a combination of the above. Felt may also be included in the 'hybrid' systems.

The resins used may also be different than those used for gravity lines. Vinyl ester and epoxy resins are the more commonly used thermoset resins for pressure lines.

The mechanical properties of the resins designed for pressure pipes work in synergism with the reinforcing media and the fatigue resistance is much better than for polyester resins. Fatigue is a phenomenon that deteriorates liner properties due to 'flexing' of the liner caused by pressure variations in the line.

Designing liners for pressure lines is a much more complicated process requiring a very clear definition of the variables associated with the project and the construction of the liner. Adhesion between the resin used and the reinforcement is crucial in reaching optimum mechanical properties.

Along with different liners and different resins, the processing of CIPP liners in pressure applications is different. Since there is no easy access to pressure lines, some digging is generally required to access the deteriorated pipe to be relined. Reinstating any services in the pressure line is also a more complicated procedure than for gravity lines.

With pressure lines, adhesion between the liner and host pipe must be taken

into consideration. If there is adhesion, lateral considerations are different than if no adhesion exists. Designing a lateral reinstatement that is pressure tight is crucial. Knowing if the liner will adhere to the host pipe long term is also important.

In gravity lines, estimating the liner service life is accomplished by using flexural creep calculations. In pressure lines, tensile creep will be used to define service life. Creep analysis considers the deterioration of tensile properties over time and under stress. After 10,000 hours of actual data, a regression line is plotted through the data points. The formula for the regression line is used to extrapolate a data point at 50 years. That 'long-term' value will be used in the design calculations to construct the liner.

While the CIPP process is not new, use of this process is relatively new. As raw materials become available to provide the needed properties, and as contractors develop the process to install, CIPP liners used to successfully renovate pressure pipelines is no longer a 'thing of the future'. 🌐

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