UV-Cured CIPP Lining – The Future of Pipeline Rehabilitation is Bright

Jeff Maier
C&L Water Solutions, Inc.

Cured-in-place pipe (CIPP) lining is one of the most commonly utilized trenchless methods for the rehabilitation of sewer and storm water pipelines. With the invention of CIPP lining in 1971, a methodology to repair existing pipeline infrastructure with minimal disruption was realized, providing a new fully structural pipe within a pipe at a fraction of the time and cost of typical open-cut excavation and replacement.

CIPP liner systems consist of a resin-saturated carrier tube, either unreinforced felt or reinforced fiberglass, impregnated in most cases with polyester or vinyl ester resins. Liners are inverted or winched into place within a host pipe and cured using thermal (steam or hot water) or ultraviolet light (UV) methods. Continued refinements to the resin systems, liner manufacturing and installation processes have allowed CIPP lining to become one of the most versatile and proven pipeline rehabilitation technologies available. The emergence of UV-cured lining, in particular, is a good example of how the CIPP lining process has improved and continues to evolve as a technology.

The development of UV-cured CIPP lining has brought forth many benefits and advantages, providing owners with a high-quality lining system that addresses specific needs such as infiltration control, stringent QA/QC requirements and improved structural strengths, while incorporating sustainable and environmentally responsible manufacturing and installation processes.

Compared to traditional felt CIPP lining, UV-cured CIPP offers a higher-strength, fiberglass-reinforced lining system that is cured using UV light rather than using steam or boiling water. The polymerization process is photo-initiated using light energy rather than thermally initiated. It features an impermeable outer membrane that serves to both contain the styrenated resins as well as prevent outside ground water from adversely affecting the curing process, with the resins protected from emulsification and dilution issues. UV-cured CIPP lining, due to its reinforced fiberglass-and-resin composite construction, allows for significantly thinner liner design thicknesses to be utilized, providing improved flow characteristics and less inner-diameter constriction of the pipeline compared to traditional felt lining systems.

The design approach for CIPP, both UV and felt lining, utilizes criteria described in ASTM F1216, which provides well-defined structural design methodology based on a number of factors including liner material properties, installation depths, groundwater levels, soil conditions and consideration of live loads. Because of the reinforcement matrix used within the UV-CIPP carrier tube, less shrinkage is realized compared to unreinforced CIPP materials, which provides a tighter fit to the host pipe and reduced water jacketing effects. By design, CIPP lin-

ing provides a tight fit lining solution and does not bond to the host pipe. Another advantage is that shelf life of UV-CIPP liners is typically several months, while felt liners need to be installed within a few days after wet-out. The longer shelf life provides significant flexibility in manufacturing, overland shipping and project scheduling.

For installation, UV-cured CIPP lining tubes are winched into place within a pipe, rather than relying on the inversion methods commonly utilized by traditional felt CIPP lining. The equipment footprint is significantly smaller than that of a thermal cure CIPP installation, as the UV curing process does not require boilers or steam towers. Consequently, fuel consumption in the UV curing process is less than 10% of a typical

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thermal liner cure that uses steam or hot water methods.

When the liner is positioned within the pipe, the liner is inflated using air pressure and then a train apparatus carrying the UV light system is inserted. Prior to curing, a pre-inspection video is taken using an integrated CCTV camera located on the front of the UV light train to ensure that the liner is positioned properly and that there are no issues. This extra inspection step, prior to turning on the UV lights, provides a distinct quality control advantage compared to other lining methods, and results in fewer wrinkles, fins or other potential defects.

Once started, curing typically takes a fraction of the time of required for steam and hot water methods, and provides a highly accurate and consistent final lining product that is documented throughout the process. Thermal sensors on the light train monitor the curing process and detect any heat sinks that may require additional energy to ensure proper cure, and through this computer-controlled process, the UV light train speeds up or slows down accordingly. Once completed, there is no cooling-down period or concerns related to disposal or treatment of styrene-contaminated curing water, which is a common issue with curing via steam or hot water.

Over the past decade, UV-cured CIPP production and installation has more than doubled in the North American market. Within the Rocky Mountain region, UV-cured CIPP lining has become a preferred solution for rehabilitation of sanitary and storm sewer pipelines where infiltration and wet pipe conditions are prevalent, and when higher-strength liner solutions are required. Because the styrenated resins are contained within the protective outer bladder layer, the lining system provides a viable alternative in environmentally sensitive areas and where styrene odors need to be minimized. Although glass-reinforced liner material production costs are somewhat higher compared to unreinforced felt liners, efficiencies realized during the installation process and shorter cure times can result in cost savings, often allowing UV-cured CIPP to be directly competitive with traditional CIPP liner systems.

As this technology becomes more readily available throughout North America, an increasing number of utility owners are taking notice. With more qualified contractors now offering UV-cured CIPP lining as an option, and more liners being produced in North America instead of being shipped over from Europe, pricing and availability continue to improve. The future is bright for UV-cured CIPP lining, with significant growth and increased presence in the pipeline rehabilitation market projected to continue.