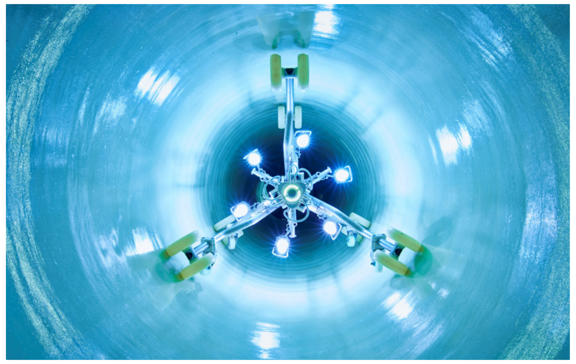
TECH TIPS FROM NASSCO

LIGHT CURE CIPP

By NASSCO Pipe Rehab Committee Chair Bill Moore, AOC

The Cured-In-Place Pipe (CIPP) process has a track record of more than 50 years. It has a demonstrated success record for the trenchless rehabilitation of underground linear infrastructure. As the name implies, the process involves inserting a flexible liner into the pipe to be rehabilitated, and then curing the liner inside the pipe, resulting in a new pipe.

Most CIPP uses polyester or vinyl ester thermosetting resins. These resins are cured by a process known as free radical polymerization. During this polymerization process, the polymer is cross-linked with a reactive diluent or monomer. This free radical polymerization requires an initiator to start the reaction. Heat cured systems use organic peroxides to initiate the reaction. When heat is applied, the organic peroxide breaks down to form free radicals which attack the double bonds in the polymer chains and reactive diluent, starting the reaction process. The reactive diluent, or monomer, creates cross links between the polymer chains during the curing process, eventually forming the composite matrix. For light cure applications, the reaction is similar, but light curing initiators are used. These initiators form free radicals when exposed to a particular wavelength of light.



Light curing has found an increasing presence in the CIPP industry, and actually has a larger market share than heat curing in Europe. Most light cure systems use metal halide bulbs. These bulbs supply light over a wide range of the light spectrum with the largest amount of energy focused in the UVA (320 to 400 nm) and UVB (280 to 320 nm) spectrums. Different light cure initiators react more efficiently to particular wavelengths of light. The UV initiator package used in the resin can therefore be optimized to match a particular light curing system. Over the last decade or two, a number of light cure systems using LED lights have been introduced to the industry. Unlike the metal halide systems, LED lights are generally focused at a particular wavelength on the light spectrum. The most common systems are concentrated around 410 nm or 450 nm, which actually falls in the blue light spectrum. Because the LED systems only produce light at a particular wavelength, it is even more important to have the light cure initiator package optimized for that particular wavelength.

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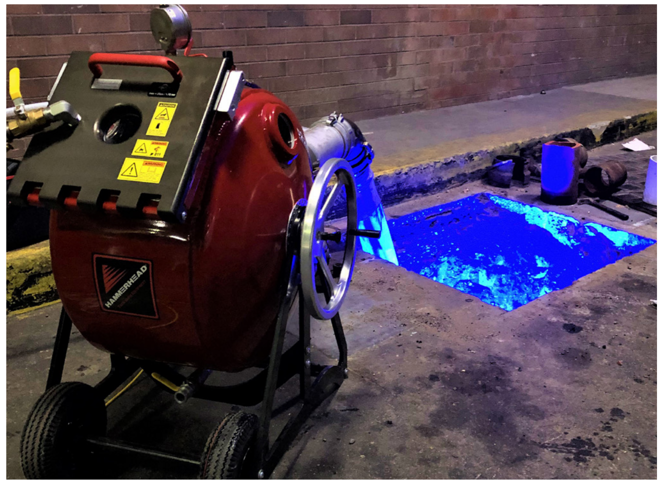

Most standard light cured liners are made out of layers of fiberglass fabric. Fiberglass has a similar refractive index to the polyester and vinyl ester resins which allows for more efficient light penetration. There are, however, limits to how far the light can penetrate the liner, which will determine the maximum thickness that can be installed (unless used in combination with other heat-activated initiators). The fiberglass reinforced liners have a very high flexural modulus which allows for thinner liner designs. Fiberglass reinforced liners also generally have better long-term creep retention properties which, again, contributes to thinner design values. Fiberglass and resin manufacturers have also developed new products which improve the ability to cure through thicker laminates. This has become increasingly important as light cure manufactures have significantly expanded the diameter range available in the production of these liners. Fillers are typically not used with light-cured resins, with the occasional exception of alumina trihydrate (ATH), which also has a reactive index that is a close match to the resin and fiberglass. The ATH will, however, have some impact to the thickness that can be cured.

LED cure systems are most widely used in smaller dimeter applications. Their flexibility and smaller footprint make them ideally suited for use in lateral applications where you need the ability to handle bends and transitions. These systems typically use woven or needle punched liners which have significantly more flexibility than a glass-reinforced liner. Traditional polyester needle punched felt liners, or glass/felt hybrid liners are also now being installed using an air inversion or a pull in process and then cured with the same metal halide light train systems used for glass-reinforced liners. These felt liners will have a little lower thickness limitation compared to an all-fiberglass liner. The use of felt liners can provide a lower cost compared to a glass reinforced liner, however thicker liners will need to be installed due to the lower flexural modulus of these systems.

The light cure CIPP market continues to see good growth year after year and has picked up additional market share around the world. The suppliers, equipment manufacturers, and installers also continue to innovate new products and procedures to help continue this trend.

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