



Caltrans Division of Research,
Innovation and System Information

Research

Results

Design

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Project Title:

Environmental Effects of Cured-in-Place Pipe (CIPP) Repairs

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Environmental Effects of Cured-in-Place Pipe (CIPP) Repairs

CIPP installations were flushed with water to measure concentrations of constituents that may occur due to the materials used.

WHAT WAS THE NEED?

Prior to this study, pollutant discharge concentrations at Cured-in-Place Pipe (CIPP) installations that followed the allowable CIPP installation methods in The California Department of Transportation (Caltrans) specification were not available. One of the notable challenges of implementing this trenchless culvert rehabilitation method, using styrene-based resins, is the leaching of styrene, a volatile organic compound (VOC), into water that flows through the culverts. Thorough curing theoretically immobilizes styrene, but the degree of effectiveness in Caltrans installations should be assessed to ensure the Caltrans specifications are adequately protective of water resources.

Previous research suggests VOCs could occur as a result of CIPP installations at levels which may be toxic to sensitive species. Further investigation revealed that elevated concentrations can be attributed to poor installation practices. However, previous studies did not test water quality from installations which followed Caltrans specifications. Without this information, California water quality regulators were considering a moratorium on CIPP for surface drainage or they were adding additional monitoring requirements via the 401 permitting process. Caltrans needed data that would either justify the continued use of the Caltrans specification or provide insight into specification improvements.

WHAT WAS OUR GOAL?

Our goal was to collect VOC data for the most common and environmentally friendly CIPP methods and materials identified in the Caltrans specification and compare that data to environmental thresholds.



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WHAT DID WE DO?

To conservatively measure the water quality impacts of CIPP method, a small volume of water was introduced immediately after CIPP installations of 11 pipes. Minimizing the volume of water used to flush the pipes theoretically results in higher concentrations of chemicals residual to the CIPP installation materials. Water quality analysis of induced flows through pipes lined by various CIPP methods demonstrated that close adherence to the Caltrans specification for CIPP installation is critical to avoid environment impacts.

WHAT WAS THE OUTCOME?

Though this study did not include replication, the preponderance of the data from field and simulated-field experiments indicates that CIPP, with some care in enforcing the Caltrans specification and delaying the reintroduction of natural flow, will result in concentrations of VOCs that will not likely impact downstream receiving waters.

Some measured concentrations were above the toxicity threshold for sensitive aquatic species, however, all concentrations were below all other known toxicity thresholds (e.g. trout). To be protective of water flowing through the CIPP, enhancements may be necessary to protect the most sensitive aquatic species.

Cure method had a clear benefit to the most concerning constituent, styrene. UV curing was clearly superior and the other volatile concentrations detected were all measured at levels below known environmental thresholds.

The water quality results, in terms of protection of aquatic species, can be categorized by soil conditions. For unsaturated soil conditions, UV-cured resin, styrene-free resin, and steam-cured,

styrene-base resin with forced heated air treatment would be protective of all aquatic species without the need to divert flow. For all other scenarios, water cannot be allowed to flow through the pipe until 96 hours after CIPP installation. For saturated soil conditions, UV-cured and non-styrene CIPP met all water quality criteria. For styrene-based CIPP in saturated conditions, forced heated air appears to be a contributing factor to bring concentrations below environmental thresholds by Day 4.

Additional enhancements may be necessary for saturated soil conditions that are presumably causing a heat sink that may be inhibiting the curing process.

WHAT IS THE BENEFIT?

CIPP is a cost and time-saving method to rehabilitate pipe. Keeping CIPP as a viable option saves project costs and impacts to the motoring public. Identifying conditions where some CIPP methods are inappropriate or where special conditions are added to the specification will protect the public resource of clean water. Other Department's of Transportation (DOTs) and stormwater management agencies will also benefit from these results.

The research concluded that the Caltrans specification is protective of water quality except for special cases where additional conditions should be considered in the reevaluation of the Caltrans specification.

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