

METRO WASTEWATER RECLAMATION DISTRICT

MEMORANDUM

TO: Sewer Work Group

DATE: June 7, 2005

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SUBJ: JPCI Environmental Coatings Sewer Shield Rehabilitation Product Evaluation

EXECUTIVE SUMMARY

On May 11 and 12, 2005, Metro Wastewater Reclamation District (District) staff visited Phoenix, AZ to evaluate the condition of existing manholes, lift stations, and other structures that have been rehabilitated with Environmental Coatings products. The evaluation consisted of interviews with property owners who have used these products, as well as physical inspection of the product applications. A total of twelve structures were inspected and representatives from three municipalities were interviewed. The purpose of the evaluation was to investigate the long-term effectiveness of Environmental Coatings products installed in severely corrosive environments, and to determine if these products are a viable rehabilitation option for the District's transmission system. From this evaluation, the Environmental Coatings products have demonstrated the ability to withstand extremely corrosive environments with no known failures to date and should be considered a viable alternative for rehabilitation projects.

PROBLEM STATEMENT

Currently, there are two rehabilitation products approved by the District for use in highly corrosive environments. These products, plastic lining (T-Lock) and cured-in-place epoxy resin liners (Poly-Triplex), have known limitations and are not always appropriate for structures in need of rehabilitation. Plastic lining is limited to precast structures. Installation standards for benches, inverts and most channels have not been developed. Cured-in-place epoxy resin liners are limited to round structures. Structures that contain a flat top manhole or a vault have proven to increase both installation complexity and risk of failure. Both products require complete bypass pumping for invert lining. Today, the District has no approved product for use in highly corrosive environments that can be applied using a flow-thru plug. A product that is versatile in application, highly corrosion resistant, and cost effective is needed to serve as a viable alternative in upcoming manhole and structure rehabilitations.

BACKGROUND

Joseph Painting Company, Inc (JPCI) has been in business since 1972. Environmental Coatings is a wholly owned subsidiary of JPCI. Sewer Shield, manufactured by Environmental Coatings of Mesa, AZ, is a coating system used to rehabilitate structures and provide protection from further hydrogen sulfide (H₂S) corrosion. The product system is a high-build, acid resistant, Novolac epoxy liner coating applied from 0.125-inch to 0.25-inch thick.

In some cases, a base layer of calcium aluminate (C120) mortar is used to rebuild and enhance the corroded structure to allow for a monolithic application of Sewer Shield. The C120 base layer is trowel applied, with a recommended thickness ranging from 0.75-inch to 2-inch, and a maximum thickness of up to 4-inches. The calcium aluminate mortar serves as a durable, corrosion resistant base layer underneath a top layer of epoxy. Installation procedures require a dry surface, which could be accomplished using a flow-thru plug. Typically, a Sewer Shield application will require more than one day to install due to the two-layer approach. Costs per application are comparable with cured-in-place epoxy resin liners.

150 The Sewer Shield epoxy is available in two grades: Sewer Shield 100 (98% acid resistant), which is used primarily in severely corrosive environments, and the less expensive Sewer Shield 101A (75% acid resistant), which is used mainly in less corrosive environments and in new construction for corrosion prevention. Either epoxy grade can be applied directly onto new concrete structures to prevent corrosion from occurring. An underlayment of C120 is only recommended when a smooth surface is not available.

Environmental Coatings has also developed a Composite manhole. The Composite manhole is a pre-formed, fully structural rehabilitation product that is made from the same acid resistant resins as Sewer Shield 100 epoxy, integrated with spun fiberglass structural fibers. This product can withstand H-20 loading and can be installed in a matter of a few hours, thus allowing for minimal bypass pumping and/or traffic control time. For structures that require significant bypass pumping and or excavation to rehabilitate, the composite manhole may be considered as a viable cost-effective alternative.

Once the Sewer Shield products are installed, a spark test (holiday test) is required. Environmental Coatings recommend using between 14 and 25 kV to test applications from 0.125-inch to 0.25-inch thickness respectively. A comprehensive visual inspection is also recommended during the testing process. See Appendix A – Sample Specifications.

In 2004, the District had MH BG 005 on the Brantner Gulch Interceptor rehabilitated with Sewer Shield 100 as a product demonstration. There are also several other structures located on the Upper Weir Gulch and Aurora Westside Interceptors that have Sewer Shield 100 applied to the bench and channel areas only.

OBJECTIVES AND SCOPE

The objective of this evaluation is to determine if products manufactured and applied by Environmental Coatings are appropriate alternatives to use for District rehabilitation projects.

Evaluation tasks completed to date include:

- Interview municipalities in the greater Phoenix area regarding the use of Sewer Shield products in their collection systems.
- Physically inspect and perform atmospheric monitoring of structures that have been rehabilitated using Sewer Shield.
- Obtain and analyze Sewer Shield product data and technical information.
- Obtain a sample Technical Design Standard and Technical Specification for application and installation of Sewer Shield rehabilitation products.
- Develop a product evaluation report with recommendations for use.

ANALYSIS

The evaluation consisted of discussions with JPCI staff, interviews with municipalities who have used Sewer Shield products, and physical inspection of manholes, lift stations, and structures where the products have been applied. Detailed inspection results and interview notes are included in Appendix B and C.

Inspection Results

Inspection of structures rehabilitated with Sewer Shield products took place on May 11 and 12, 2005 in the greater Phoenix, AZ area. Metro District staff physically inspected the condition of a variety of manholes and other structures to evaluate the long-term effectiveness of Sewer Shield products installed in severely corrosive environments.

The structures chosen for evaluation were either some of the oldest product installations available and/or had the most severely corrosive environments. Accessibility, safety, and traffic control issues played a role in determining which structures would be inspected. A total of 12 structures were evaluated in the cities of Phoenix, Mesa, and Gilbert. The inspected structures were an ample representation of the Environmental Coatings existing product line. See Appendix B.

Evaluation of these structures included physical entry (when possible), probing of the internal surfaces, visual inspection, and atmospheric monitoring to include H₂S and temperature. The structures inspected were of varying function, H₂S levels, and ages, but were all consistently in very good condition.

The most significant inspections were that of two manholes located at the end of a siphon outfall in the City of Phoenix, and one manhole located at the end of an 11 mile force main in the City of Mesa – Turner Ranch Treatment Plant. The Phoenix manholes were located at 51st and Broadway and were rehabilitated with Sewer Shield about 9 years ago (see Appendix B). The instantaneous H₂S readings for both of these manholes were 528 ppm and 392 ppm respectively. The Mesa manhole had instantaneous H₂S readings of 1000+ ppm. The overall condition of all three manholes, which were rehabilitated with the two-layer Sewer Shield 100 and C120 combination, was very good. The coatings were holding up well and the structures looked as if they had just been rehabilitated. See Appendix D for photos and details.

From the physical evaluation, District Staff concluded the Phoenix area sewer systems generally experience far greater H₂S levels and corrosive conditions than are present in the Metro District transmission system. H₂S levels observed in the greater Phoenix system exceeded the maximum H₂S levels for the Metro District Transmission system and provide an adequate proving ground for the products developed by Environmental Coatings.

Interview & Discussion Results

During the visit to Arizona, representatives from three Phoenix-area municipalities, currently using Environmental Coatings products in their collection systems, were interviewed to get their perspective on the products. The municipalities interviewed were the City of Phoenix, the City of Mesa, and the Town of Gilbert. All of the municipalities have been facing the same challenges of highly corrosive sewer environments along with rapid population and expansion growth.

The municipalities interviewed stated products manufactured and applied by Environmental Coatings are the only rehabilitation products that have consistently worked without a problem in their systems. Despite numerous interviews, District Staff was unable to discover a single incident of dissatisfaction using Sewer Shield as a primary rehabilitation product. The few problems that were identified were fully covered under the 5-year product warranty. All interviewed expressed dissatisfaction with other rehabilitation and corrosion prevention products including T-Lock plastic lining and Sauereisen.

Overall, the opinion of Environmental Coatings products was overwhelmingly positive from the municipalities interviewed. Not only did these municipalities highly recommend the use of Environmental Coatings products, but some are even working toward a sole-source agreement to use the products for all their rehabilitation needs. A detailed account of each interview is located in Appendix C – Interview Notes.

Cost Analysis

Environmental Coatings products vary in cost depending on the grade of acid-resistant epoxy used and the amount of C120 calcium aluminate used as a base layer underneath prior to the epoxy application. Overall, the cost to rehabilitate a corroded manhole or structure using the two-layer system of C120 and Sewer Shield 100 is comparable to the cost of Poly-Triplex lining, offering similar high-end protection. Project cost savings can be realized with Sewer Shield when flow-thru plugs are utilized during rehabilitation instead of bypass pumping.

The Environmental Coatings products provide superior protection in highly corrosive environments (PH < 2, H₂S levels of 100 ppm or higher) compared to basic calcium aluminate mortars, or other less corrosion resistant epoxy products. According to the municipalities interviewed, the long-term cost/benefit analysis of using Sewer Shield for rehabilitation is very favorable.

The composite manhole is designed for manholes that have been structurally compromised. It is expected this product would only be used to avoid excessive excavation costs.

Warranty Analysis

The Sewer Shield epoxy products come with a 5-year unconditional bonded warranty from both the product manufacturer (JPCI/Environmental Coatings) and the installation contractor. The Sewer Shield Composite Manhole comes with a 25-year warranty against defects in materials and workmanship.

The warranty provided by Environmental Coatings is very competitive with other rehabilitation products. Poly-Triplex provides a 10-year manufacturers warranty for its liner system and most other products offer a 2-year warranty against defects in materials and workmanship.

ALTERNATIVE SOLUTIONS

Two rehabilitation products, plastic lining (T-Lock) and cured-in-place fiberglass epoxy liners (Poly-Triplex), are currently approved by the Metro District for use in highly corrosive atmospheres.

Plastic lined structures in the District's Transmission system have held up well in moderately corrosive environments (H₂S levels at 25-100 ppm). Insufficient data exists for the durability of

plastic lining in highly corrosive environments (above 100 ppm), however discussions with several municipalities in the Phoenix area revealed that numerous plastic lining failures have occurred in their structures with high H₂S levels. Plastic weld strips appear to be the inherent weakness of the plastic lining products and the source for almost all failures observed. Plastic lining has not been proven to be a cost effective alternative for rehabilitating benches and inverts.

In 1997, a Poly-Triplex liner was installed in MH ST 42 on the South Thornton Interceptor as a product demonstration. MH ST 42 is considered to have a highly corrosive environment with typical H₂S levels in the range of 150-200 ppm. This structure was recently evaluated and showed no signs of deterioration. Approximately 50 additional manholes were recently rehabilitated using Poly-Triplex liners as part of the South Thornton Manhole Remediation project (PAR 844). The observed limitations for the Poly-Triplex liner include increased installation complexity for non-round structures. Hollow spots and "tenting" are common where the liner does not properly cover a sharper angle or transition within the structure, such as with a flat top manhole.

A limitation of both the plastic lining and fiberglass epoxy liners is their lack of structural integrity. The Sewer Shield Composite Manhole provides both structural integrity and corrosion resistance. As with all rehabilitation products, strict guidelines for installation and a follow up inspection schedule for warranty work is critical and should be included in the scope of the initial project.

RECOMMENDATIONS

For the Arizona climate, Environmental Coatings rehabilitation products have performed consistently well over a long period of time in highly corrosive environments with no known failures. The municipalities of Phoenix, Mesa, and Gilbert have all stated products manufactured and applied by Environmental Coatings are their preferred solution for rehabilitation projects. Even with significant chemical dosing programs in place, atmospheres have shown to routinely exceed 500 ppm for H₂S, which exceeds the H₂S levels observed in the Metro District's transmission system.

Unlike existing approved rehabilitation products, the Sewer Shield product can be applied using flow-thru plugs to handle flows in many situations, providing a significant cost savings by eliminating the need for bypass pumping. When structural integrity is compromised, the Sewer Shield Composite manhole may be a practical option due to the relatively short time for installation, which keeps pumping and traffic control time to a minimum, while providing corrosion resistant, structural rehabilitation.

From this evaluation, Environmental Coatings products have demonstrated the ability to prevent corrosion in the most severe environments and should be considered a viable alternative for all rehabilitation projects where moderate to high H₂S levels are present.

APPENDICES

- Appendix A – Sample Specifications
- Appendix B – JPCI Sewer Shield Product Evaluation – Structures Inspected
- Appendix C – JPCI Sewer Shield Product Evaluation – Interview Notes
- Appendix D – Photos