Texas Commission on Environmental Quality
Interoffice Memorandum

To: Commissioners **Date:** August 12, 2011

Thru: Melissa Chao, Acting Chief Clerk
Mark R. Vickery, P.G., Executive Director

From: L'Oreal Stepney, P.E.
Office of Water

Subject: Consideration of a Petition for Rulemaking

Docket No: 2011-1164-RUL

Project No: 2011-049-PET-NR

Who Submitted the Petition:
Eric J. Dupré submitted the petition to the commission on July 11, 2011.

What the Petitioner Requests:
The petitioner requests that the commission amend 30 TAC §217.55 (Manholes and Related Structures) and §217.60 (Lift Station, Wet Well, and Dry Well Designs) to include design criteria to rehabilitate existing manholes, lift stations, and other wastewater treatment plant structures. The current rules only address design criteria for new facilities and do not address rehabilitation needs for these structures. The petitioner states that corrosion is the leading cause of premature failure of concrete and masonry structures and Chapter 217 is missing key minimal design standards to help correct this issue found all over the State of Texas in every county.

As text for the proposed rules, the petitioner provides the following language to be included:

Manhole and Lift Stations Rehabilitation
"Surface of preparation is the first step in a successful application of Manhole Mortar product. Surface shall be hydroblasted to clean, remove loose debris, and to etch the surface back to solid substrate up to ¼ "anything beyond ¼" is not surface prep but hydro demolition a different scope of work. Once that is completed the next step is to moisten the surface of the substrate with water just enough to be damp or **SSD** Saturated Surface Dry. Then the structure is ready to have Manhole Mortar applied to it. Once all gases have reached a safe level naturally or by supplied fresh air the Nozzelmen shall conform to **OSHA** confined space regulations and lowered into place to be able to start spray applying the product to the substrate surface at its proscribed thickness not to exceed 4 inches in a single application. Once surface area has been completely sprayed by the Nozzelmen it will then be steel trowel out having a sealed smooth surface. If a top coating of Epoxy is to be applied to this surface it will receive a brushed tooled finish to allow the epoxy to anchor onto it (see epoxy manufactures recommendation, ASTM, or SSPC standards). Once all these steps have been executed properly the mortar will have already begun to cure and will increase in strength within 24 hours, 7 days, and peak at 28 days. In

order to be considered an approved equal product must meet or exceed physical properties shown on the Manhole Mortar Data sheet. The information subsequent to this paragraph goes into further technical details of the entire process which conform to **ASTM F2551** guidelines for using a cementitious liner system to rehab manholes. This specification can also be applied to other structures such as Lift Stations and/or other deteriorated concrete or masonry structures."

Protective Coatings
"All concrete/metal structures exposed to H_2S and other harsh corrosive materials shall be coated with an epoxy coating in order to resist premature failure and maintains design thickness without compromise."

Recommended Action and Justification:
TCEQ recognizes that there is a need to add design criteria to rehabilitate existing manholes and lift stations to minimize premature failure of such infrastructure due to corrosion, the current rules do not prohibit adding these requirements. Under the existing rules (Chapter 217), the owner of a new collection system must ensure that the structural life cycles of such infrastructure last at least 50 years. Without such requirements, some infrastructure may last closer to 15 years or even less, depending on the configuration of the systems and the concentration of pollutants in the waste streams. Infrastructure associated with the discharge from long force mains is especially vulnerable to corrosion due to low pH.

It should be noted that the current design criteria is mainly intended for new construction and is silent on the rehabilitation of existing infrastructure, leaving such responsibility to the owner and engineer to determine how to fix the problems. Currently, the commission does not review and/or approve routine maintenance of the collection systems. The only section within the existing criteria that deals with collection system rehabilitation is the portion that deals with trenchless pipe installation, which defines the technologies that may be used for lining existing collection system pipes. The petitioner is asking that the commission consider expanding this section of the rule to also include manholes and lift stations.

Because of the importance of these changes, the Executive Director recommends that the petition be denied at this time and the staff addresses the issue presented by the petitioner, along with other potential revisions, through a comprehensive stakeholder process.

Applicable Law:
- Texas Government Code, §2001.021, which establishes the procedures by which an interested person may petition a state agency for the adoption of a rule;
- 30 TAC §20.15, which provides such procedures specific to the commission;

- Texas Water Code (TWC), §5.013, which establishes the general jurisdiction of the commission over other areas of responsibility as assigned to the commission under the TWC and other laws of the state;
- TWC, §5.102, which establishes the commission's authority necessary to carry out its jurisdiction;
- TWC, §5.103 and §5.105, which authorize the commission to adopt rules and policies necessary to carry out its responsibilities and duties under TWC, §5.013;
- TWC, §7.002, which authorizes the commission to enforce provisions of the TWC;
- TWC, §26.027, which authorized the commission to issue permits;
- TWC, §26.034, which provides the commission's authority to adopt rules for the approval of disposal system plans; and
- TWC, §26.121, which provides the commission's authority to prohibit unauthorized discharges.

Agency contacts:
Jaya Zyman-Ponebshek, Project Manager, 239-2012, Water Quality Division
Kathy Humphreys, Staff Attorney, 239-3417
Bruce McAnally, Texas Register Coordinator, 239-2141

Attachment
Petition

cc: Chief Clerk, 2 copies
Executive Director's Office
Susana M. Hildebrand, P.E.
Anne Idsal
Curtis Seaton
Ashley Morgan
Office of General Counsel
Jaya Zyman-Ponebshek
Kathy Humphreys
Bruce McAnally

TCEQ Rules Petition

Submittal:
7/11/2011
To:
Texas Commission on Environmental Quality
PO Box 13087
Austin, TX 78711-3087

Petitioner:
Eric J. Dupre'

Introduction and Object of proposed rule:

Identify that Chapter 217 Design Criteria for Wastewater Systems does *not have any rules* or minimal design criteria in regards to trenchless rehabilitation of existing manholes, lift station, and other vital system components. **Corrosion is the leading cause of premature failure of concrete and masonry** structures and Chapter 217 is **missing key minimal design standards to help correct this issue found all over the State of Texas in every County**. The design phase is the most important and critical point before actual procurement or construction begins therefore by not having any minimal design criteria on some of the most frequently performed procurements leaves a large uncontrolled variance in what is or isn't being done. *The Director of the U.S. Department of Defense has also gone on to say that of all the Federal, State, and local governments, there is no central process or mechanism for curbing the cost of mitigating infrastructure corrosion. Nonetheless, it is paramount that we follow certain corrosion prevention and mitigation protocols as we repair and rebuild our aging infrastructure*. Currently product manufactures have more influence and control than the State of Texas because these rules/ minimal standards do not currently exist in Chapter 217. The industry is begging to have some type of consistent and uniformed standard across the State of Texas.

Rules in which could be effected by addition of this missing criteria:

Currently there are **no rules or design criteria** to rehab existing manhole, lift stations or WWTP structures so the rules would need to be added not to change or amended.
Rule **217.55** Manholes and Related Structures (does not cover existing structures)
Rule **217.60** Lift Station, Wet Well, and Dry Well Designs (does not cover existing structures)
But not limited to newly built or existing concrete/masonry structures exposed to harsh **H_2S** gases found in heads works, and other turbulent/ volatile components found in the Wastewater System.

Language to be adopted and/or injected into Chapter 217 as seen fit for its uses and applications:

Manhole and Lift Stations Rehabilitation
Surface of preparation is the first step in a successful application of Manhole Mortar product. Surface shall be hydro blasted to clean, remove loose debris, and to etch the surface back to solid substrate up to ¼" anything beyond ¼" is not surface prep but hydro demolition a different scope of work. Once that is completed the next step is to moisten the surface of the substrate with water just enough to be damp or **SSD** Saturated Surface Dry. Then the structure is ready to have Manhole Mortar applied to it. Once all gases have reached a safe level naturally or by supplied fresh air the Nozzelmen shall conform to **OSHA** confined space regulations and lowered into place to be able to start spray applying the product to the substrate surface at its proscribed thickness not to exceed 4 inches in a single

application. Once surface area has been completely sprayed by the Nozzelmen it will then be steel trowel out having a sealed smooth surface. If a top coating of Epoxy is to be applied to this surface it will receive a brushed tooled finish to allow the epoxy to anchor onto it (see epoxy manufactures recommendation, ASTM, or SSPC standards). Once all these steps have been executed properly the mortar will have already begun to cure and will increase in strength within 24 hours, 7days, and peak at 28 days. In order to be considered an approved equal product must meet or exceed physical properties shown on the Manhole Mortar Data sheet. The information subsequent to this paragraph goes into further technical details of the entire process which conform to **ASTM F2551** guidelines for using a cementitious liner system to rehab manholes. This specification can also be applied to other structures such as Lift Stations and/or other deteriorated concrete or masonry structures.

Protective Coatings
All concrete/metal structures exposed to H_2S and other harsh corrosive materials shall be coated with an epoxy coating in order to resist premature failure and maintains design thickness without compromise.

Adopted resolution from the following provided specifications and industry standards:

The following documents supplied can be used by TCEQ to inject and adopted these standards as a minimal standard for section 217.55 & 217.60. The two materials identified in the documents are the most cost effective and successfully proven products for this scope of work and for whatever reason are identified in *217.56 Trenchless Pipe Installation* (c) 1 cement mortar lining (c) 2 epoxy spray lining but not in the other mentioned sections when they are most utilized to rehabilitate manholes, lift stations, and/or WWTP.
SEE ATTACHED DOCUMENT FOR MANHOLE REHABILIATATION AND SUPPORTING DOCUMENTS

Conclusion:

Since the majority of all Professional Engineers in the State of Texas follow and use TCEQ's chapter 217 Design Criteria the State of Texas at all levels will continue to deal with these major corrosion issues and will endure the costs associated with doing nothing. If a criterion is set where it is currently missing it will enable owners to adopt some type of consistency and uniformity to help curb costs and control over their aging infrastructure. The first question contemplated when making this request was **would this rule change benefit Texans?** After much dialog with many Engineers, Professionals, and clients the answer was **unquestionably yes**. We implore this Commission take action on this matter to add these standards and criteria to strengthen the Chapter 217 Design Criteria. We thank you for your time and efforts with this matter. Please contact Eric Dupre' at 956.763.7898 or eric@SouthernTrenchless.com, if you have any questions or need additional information.

Respectfully
Eric J. Dupre'

cc: Senator Dan Patrick
Texas House Rep Bill Callegari
Cheli Castro

Designation: F 2551 – 09

Standard Practice for Installing a Protective Cementitious Liner System in Sanitary Sewer Manholes[1]

This standard is issued under the fixed designation F 2551; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

A sanitary sewer manhole may be repaired or rehabilitated by applying a prepackaged cementitious liner to the interior surface after it has been properly prepared and cleaned. Sanitary sewer manholes can be damaged by dynamic loading, abrasion, erosion, and corrosion.

1. Scope

1.1 This specification describes all the work required to structurally reinforce, seal, and protect sanitary sewer manholes. Applications include applying a prepackaged cementitious liner that can function as a full depth restoration or a partial depth repair. A uniform high-strength, fiber-reinforced cementitious mortar should be manually sprayed and hand troweled or centrifugally cast in a uniform, prescribed thickness to all cleaned, interior surfaces from the bottom of the frame to the bench. The cementitious liner may be applied to manholes constructed of brick, concrete, block, and various other materials.

1.2 A manufacturer's approved applicator shall furnish the complete application of the protective, prepackaged cementitious liner material. All of the cleaning, preparation, and application procedures shall be in accordance with the manufacturer's recommendations.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Manholes are permit required confined spaces in accordance with OSHA definition and should be treated as such, requiring confined space entry permits, appropriate monitoring equipment, and the associated personal protective equipment.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete

C 494/C 494M Specification for Chemical Admixtures for Concrete

C 969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C 1140 Practice for Preparing and Testing Specimens from Shotcrete Test Panels

C 1244 Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

C 1315 Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

F 2414 Practice for Sealing Sewer Manholes Using Chemical Grouting

2.2 *ACI Standards:*[3]

ACI 301-05 Specifications for Structural Concrete

ACI 305R-99 Hot Weather Concreting

ACI 306R-88 Cold Weather Concreting

ACI 308R Practice for Curing Concrete

ACI 506R Guide to Shotcrete

[1] This practice is under the jurisdiction of ASTM Committee F36 on Technology and Underground Utilities and is the direct responsibility of Subcommittee F36.20 on Inspection and Renewal of Water and Wastewater Infrastructure.

Current edition approved May 1, 2009. Published June 2009.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.concrete.org.

2.3 *ICRI Technical Guidelines:*[4]

Guideline No. 03732 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

Guideline No. 03737 Guide for the Preparation of Concrete Surfaces for Repair Using Hydro-demolition Methods

3. Ordering Information

3.1 *Submittals*—Orders for all prepackaged materials listed under this practice shall include the following:

3.1.1 Product data, including manufacturer and brand name;

3.1.2 Technical data stipulating physical characteristics of applied liner material; and

3.1.3 Manufacturer's Safety Data Sheets.

3.2 *Delivery, Storage, and Handling*:

3.2.1 The prepackaged cementitious materials should be stored according to the manufacturer's recommendations. No modification should be made to the manufacturer's recommendations for handling and delivery of these products.

4. Materials and Manufacture

4.1 All prepackaged materials shall be designed, manufactured, and intended for sewer manhole rehabilitation and the specific application in which they are used. Each material shall be designed for application over damp surfaces without degradation of the final product or the bond between the product and the manhole surface.

4.2 *Materials for Substrate Repairs*—All voids and irregularities of the substrate should be filled or repaired with structurally sound materials before applying the cementitious liner material.

4.2.1 *Cementitious Repair Materials*—Hand mix and apply for filling voids and reforming benches and resurfacing the brick, concrete walls, and bench surfaces of the sewer manhole. Mix the cement repair material and apply according to the manufacturer's instructions. The cementitious liner material can be used as the repair material.

4.3 *Infiltration Water Control Materials*—Specifically formulated for stopping water leaks and minor infiltration.

4.3.1 *Cementitious Water Control Materials*—Used to stop flowing water leaks in concrete and masonry structures. This material may be applied in dry form directly to the leak area or mixed with potable water to a soft putty consistency for larger active leaks. This material is held in place until it sets and the leak stops. Mix and use according to the manufacturer's instructions.

4.3.2 No modification should be made to the products recommendations for handling, mixing, placing, and finishing without the manufacturers prior written approval.

4.4 *Chemical Grout Material*—To stop water leaks and infiltration with chemical grout, refer to Practice F 2414.

4.5 *Lining Material*—Prepackaged cementitious lining materials are specifically designed to repair or rehabilitate sewer manhole.

4.6 *Other Materials*—No other material shall be used with or added to the prepackaged cementitious liner materials without prior written approval from the manufacturer.

5. Surface Preparation, Cleaning, and Repair

5.1 The applicator is responsible to ensure that the manhole is properly cleaned and prepared.

5.2 Place wooden or plastic covers or other protective devices over the sewer manhole invert while cleaning the manhole wall and bench sections before applying the prepackaged cementitious liner. Wire mesh and fabric filters allowing water to pass are also acceptable.

5.3 Remove all foreign materials from the manhole wall and bench sections. Remove all loose and protruding bricks, mortar, and concrete. Remove metal, plastic, or brick stairs, if required, before applying the new liner. Fill any large voids with fast setting cementitious repair material.

5.4 *Surface Cleaning Procedures*:

5.4.1 *High Pressure Cleaning*—Properly cleaning the surface of the structure is critical to the success of this rehabilitation method. Use a high-pressure washer delivering a minimum of 3500 psi (2413 MPa). A minimum of two and a half gallons per minute (9.46 litres per minute) should be delivered through the spray tip. The spray tip should be kept between 6 and 12 in. (15.24 and 30.48 cm) from the surface and be held at an angle between 45° and 90° to the surface being cleaned. The spray tip should be directed across the surface at a speed of no more than one foot per second (0.3 metres per second). If the surface is especially dirty or greasy, cleaning agents may be added to the pressure washer water or the water may be heated. When hot water is required, it should be heated to 210°F (99°C). Care should be taken to clean the frame sealing surface where the lid fits into the frame, removing any debris or other materials that negatively impact the lids ability to seal against the frame. Cleaning should begin with the frame surface and progress down to and include the bench. A rotating spray nozzle may be used for cleaning, if it meets pressure and flow requirements. Care should be taken to avoid further structural damage to the existing surface.

5.4.2 In some situations, when removing existing coatings or linings, pneumatic hammers, hydro-demolition, or sand blasting may be required. Refer to Guideline No. 03732 or Guideline No. 03737.

5.4.3 Some substrates may require more surface preparation including acid washing. If acid washing is performed, the acid cleaned surface should be neutralized.

5.4.4 Remove any loose material after all preparations and cleaning has been completed. Do not allow soil, sand, debris, or runoff to enter the sewer system. Properly dispose of any deleterious materials removed from the manhole according to local, state, and federal guidelines.

5.5 *Surface Repair*:

5.5.1 *Repair the Invert and Bench Sections*—Repair any invert and bench section that exhibits visible damage, degradation, or water infiltration. Remove obstructions and loose materials from benches prior to shaping inverts. Form smooth, u-shaped channels across the floor of the manhole. Use a high-strength, fast-setting cementitious repair material. Control or divert the flow to allow sufficient setting time for the

[4] Available from the International Concrete Repair Institute, Inc. (ICRI), 3166 S. River Road, Ste 132, Des Plaines, IL 60018, http://www.icri.org.

material used. Make finished benches and inverts smooth without defects. Allow no accumulation of debris.

6. Mixing of Prepackaged Cementitious Repair Materials

6.1 The applicator shall bear complete responsibility for mixing of the materials, applying, and finishing of the sewer manhole repair system.

6.1.1 The prepackaged cementitious liner material should be mixed with water in accordance with the manufacturer's recommendations. Tempering of the material above the manufacturers published limits should not be allowed.

6.1.2 Use clean and potable water for mixing.

6.1.3 No modifications or changes should be made to the product without prior written approval of the manufacturer.

6.1.4 During hot weather, the cementitious liner material should be mixed at temperatures below 90°F (32.2°C) in order to avoid rapid loss of workability, to decrease water evaporation, and to prevent premature set time. Retarding admixtures Type A, B, or D that meet Specification C 494/C 494M may be used to allow work in hotter weather. However, applicators should obtain manufacturers permission or use products recommended by manufacturer. Apply admixtures in accordance with ACI 305R-99 recommendations for hot weather conditions.

6.1.5 If work is to be performed near 40°F (4.4°C), preheat the water and keep prepackaged material warm. The mix should be kept near 70°F (21.1°C). Apply in accordance with ACI 306R-88 recommendations for cold weather concreting. Some liner materials are capable of setting in cold weather; consult with manufacturer for suitability.

7. Execution—Application of the Cement Liner

7.1 *Spray Application—Manual Surface Sealing*:

7.1.1 Dampen the manhole wall surface. Surface must be damp without noticeable free water droplets or running water (surface, saturated, dry). Spray or apply the cementitious liner material to a uniform thickness as specified. Use a hand trowel to hand work and compact the manhole cementitious liner material into all the voids and crevices but do not over trowel. Allow the cementitious liner material to set as recommended by the manufacturer.

7.1.2 Spray the cementitious liner material to a nominal thickness of ½ in. (1.25 cm) in one or more passes. The thickness of the cementitious lining material applied to the surface depends on a wide array of variables. These variables include overall condition of the manhole, depth, construction materials, location, dynamic traffic load, source and state of corrosion, diameter, hydrostatic pressure, soil type, and any other factors that might impact the design of the cementitious liner. The design engineer should determine appropriate liner thickness and liner material properties and may be prepared to include the addition of protective coatings or other methods used to limit or eliminate corrosion factors. Use a wet gauge to measure applied cementitious liner material thickness at three sections of the manhole: the cone/corbel section, middle of barrel, and the barrel near the invert. The liner shall be even and uniform with a troweled, brushed, or natural finish.

7.1.3 Not all manufacturers recommend the use of a protective coating over the cementitious liner material. If the liner is to receive a top coating, then an anchor tooth finish is recommended and shall be free of curing or similar compounds. For dry gunite applications, finish in accordance with ACI 506R, using the recommended trowel.

7.1.4 Apply the prepackaged cementitious liner material from the top of the manhole down to the bench. Overlay the bench with a gradual slope from the wall to the edge of the channel. The wall and bench intersection should have a rounded and uniform radius. The thickness of the bench shall be no less than ½ in. (1.25 cm) at the edge of the channel and shall increase in the direction of the wall so as to provide the required slope.

7.2 *Spray Application—Centrifugal Process*:

7.2.1 Position the high-speed, bi-directional, rotating applicator within the center of the manhole at the lowest point desired for the new wall and commence pumping the mixed prepackaged cementitious liner material. Man-entry may be required to assure the lining has been effectively applied, as on the underside of any brickwork or around laterals. As the cementitious liner material begins to be centrifugally cast evenly around the interior, retrieve the applicator head at the prescribed speed for applying the thickness that has been selected. Controlled multiple passes in both clockwise and counterclockwise directions are made until the desired thickness is attained.

7.2.2 If the procedure is interrupted for any reason, simply arrest the retrieval of the applicator head until flows are recommenced. Verify the desired thickness with a wet gage. The liners shall be even and uniform with a brushed or natural finish. If the liner is to receive a top coating refer to 7.1.3. Benches and channels are finished by hand as in 7.1.4.

8. Curing of Freshly Applied Cementitious Liner Material

8.1 Protect the freshly applied cementitious liner from extreme weather conditions. According to ACI 301-05, ACI 305R-99, ACI 306R-88, and ACI 308R, curing compounds should be used to minimize the loss of moisture to ensure the continuation of the cement hydration process. Curing compounds are used to obtain adequate and specified strength gain of the applied material. Liquid membrane curing compounds that are specified in Specifications C 309 or C 1315 should be used for these purposes.

8.2 During hot, dry weather conditions, protect the finished cementitious liner material at early ages to prevent rapid water loss. Use an accepted liquid membrane curing compound in accordance with Specifications C 309 or C 1315 on the finished cementitious liners to limit water loss. Apply curing compounds according to manufacturer's specification. Protect liner materials in accordance with ACI 305R-99.

8.3 During cold weather application provide protection of the cementitious liner at early ages to prevent damage from freezing. Do not apply prepackaged liner, when ambient temperature falls below 40°F (4.4°C) or freezing temperatures are expected within 24 h, or both. Protect liner materials in accordance with ACI 306R-88. Some liner materials are capable of setting in cold weather; consult with manufacturer for suitability.

8.4 The sewer manhole rehabilitation system is acceptable for day, nighttime, or continuous 24-h work schedules in the proper environment.

9. Sampling

9.1 Use cylinders as in accordance with Test Method C 39/C 39M, cubes as in accordance with Test Method C 109/C 109M, or shotcrete panels as in accordance with Practice C 1140, or as specified by the manufacturer or engineer document for testing compressive strength. Make cylinders, cubes, or panels from each day's work and label each with the date, location, project, and product batch numbers. The product batch numbers are located on each cement material bag or on the pallet. Send the cylinder, cube, or panel to a third-party laboratory or the manufacturer for verification. Test the cementitious liner material for compliance with specified strengths at 28 days or in accordance with the engineer's instructions. Retain one sample for further instructions should the others fail to meet the 28-day requirement. Field samples should not be moved for a minimum of the first 24 h and should be maintained according to ASTM specifications.

9.2 The engineer should approve the inspection and quality control protocol before project startup.

10. Manhole Verification and Testing

10.1 At the owner's option, one or more of the following procedures may be employed to verify the quality of the applied liner.

10.1.1 Vacuum testing in accordance with Test Method C 1244.

10.1.2 The water ex-filtration method in accordance with Practice C 969.

10.1.3 A visual inspection which may be recorded in still or video digital format.

10.1.4 Other methods as specified by the project engineer.

11. Quality Assurance

11.1 The engineer should verify that the repaired manhole meets specifications.

11.2 If the repaired manhole does not comply with the prescribed standards, the applicator should make corrections and repeat the test procedures until design specifications are met.

12. Keywords

12.1 cement liner; cementitious liner; corrosion protection; manhole rehabilitation; manhole renewal; sanitary sewer manhole; sewer manhole; stopping water infiltration; structural enhancement; structural rehabilitation

MANHOLE REHAB SPECIFICATION

Product Application Procedure

Micro Silica Cementitious Spray Applied Structural Repair Liner for Manhole Rehab

Overview of Application of Manhole Mortar

Surface of preparation is the first step in a successful application of Manhole Mortar product. Surface shall be hydro blasted to clean, remove loose debris, and to etch the surface back to solid substrate up to ¼" anything beyond ¼" is not surface prep but hydro demolition a different scope of work. Once that is completed the next step is to moisten the surface of the substrate with water just enough to be damp or **SSD** Saturated Surface Dry. Then the structure is ready to have Manhole Mortar applied to it. Once all gases have reached a safe level naturally or by supplied fresh air the Nozzelmen shall conform to **OSHA** confined space regulations and lowered into place to be able to start spray applying the product to the substrate surface at its proscribed thickness not to exceed 4 inches in a single application. Once surface area has been completely sprayed by the Nozzelmen it will then be steel trowel out having a sealed smooth surface. If a top coating of Epoxy is to be applied to this surface it will receive a brushed tooled finish to allow the epoxy to anchor onto it (see epoxy manufactures recommendation, ASTM, or SSPC standards). Once all these steps have been executed properly the mortar will have already begun to cure and will increase in strength within 24 hours, 7days, and peak at 28 days. In order to be considered an approved equal product must meet or exceed physical properties shown on the Manhole Mortar Data sheet. The information subsequent to this paragraph goes into further technical details of the entire process which conform to **ASTM F2551** guidelines for using a cementitious liner system to rehab manholes. This specification can also be applied to other structures such as Lift Stations and/or other deteriorated concrete or masonry structures.

Surface Preparation:

5.4 *Surface Cleaning Procedures*:

5.4.1 *High Pressure Cleaning*—Properly cleaning the surface of the structure is critical to the success of this rehabilitation method. Use a high-pressure washer delivering a minimum of 3500 psi (2413 MPa). A minimum of two and a half gallons per minute (9.46 litres per minute) should be delivered through the spray tip. The spray tip should be kept between 6 and 12 in. (15.24 and 30.48 cm) from the surface and be held at an angle between 45° and 90° to the surface being cleaned. The spray tip should be directed across the surface at a speed of no more than one foot per second (0.3 metres per second). If the surface is especially dirty or greasy, cleaning agents may be added to the pressure washer water or the water may be heated. When hot water is required, it should be heated to 210°F (99°C). Care should be taken to clean the frame sealing surface where the lid fits into the frame, removing any debris or other materials that negatively impact the lids ability to seal against the frame. Cleaning should begin with the frame surface and progress down to and include the bench. A rotating spray nozzle may be used for cleaning, if it meets pressure and flow requirements. Care should be taken to avoid further structural damage to the existing surface. Prepare surfaces to be repaired by water blasting, abrasive blast, hand or power tool to remove unsound concrete, contaminants, dirt, and/or debris. Contact your Southern Trenchless Representative for information on removal techniques that are best for your application.

Mixing of Prepackaged Cementitious Repair Materials

6.1 The applicator shall bear complete responsibility for mixing of the materials, applying, and finishing of the sewer manhole repair system.

6.1.1 The prepackaged cementitious liner material should be mixed with water in accordance with the manufacturer's recommendations. Tempering of the material above the manufacturers published limits should not be allowed.

6.1.2 Use clean and potable water for mixing.

6.1.3 No modifications or changes should be made to the product without prior written approval of the manufacturer.

6.1.4 During hot weather, the cementitious liner material should be mixed at temperatures below 90°F (32.2°C) in order to avoid rapid loss of workability, to decrease water evaporation, and to prevent premature set time. Retarding admixtures Type A, B, or D that meet Specification C 494/C 494M may be used to allow work in hotter weather. However, applicators should obtain manufacturers permission or use products recommended by Southern Trenchless Representative. Apply admixtures in accordance with ACI 305R-99 recommendations for hot weather conditions.

6.1.5 If work is to be performed near 40°F (4.4°C), preheat the water and keep prepackaged material warm. The mix should be kept near 70°F (21.1°C). Apply in accordance with ACI 306R-88 recommendations for cold weather concreting. Some liner materials are capable of setting in cold weather; consult Southern Trenchless Representative for suitability.

MANHOLE REHAB SPECIFICATION

Product Application Procedure

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Application of the Cement Liner

7.1 *Spray Application—Manual Surface Sealing*:
7.1.1 Dampen the manhole wall surface. Surface must be damp without noticeable free water droplets or running water (surface, saturated, dry). Spray or apply the cementitious liner
material to a uniform thickness as specified. Use a hand trowel to hand work and compact the manhole cementitious liner material into all the voids and crevices but do not over trowel. Allow the cementitious liner material to set as recommended by the manufacturer.
7.1.2 Spray the cementitious liner material to a nominal thickness of ½ in. (1.25 cm) in one or more passes. The thickness of the cementitious lining material applied to the surface depends on a wide array of variables. These variables include overall condition of the manhole, depth, construction materials, location, dynamic traffic load, source and state of corrosion, diameter, hydrostatic pressure, soil type, and any other factors that might impact the design of the cementitiousliner. The design engineer should determine appropriate liner thickness and liner material properties and may be prepared to include the addition of protective coatings or other methods used to limit or eliminate corrosion factors. Use a wet gauge to measure applied cementitious liner material thickness at three sections of the manhole: the cone/corbel section, middle of barrel, and the barrel near the invert. The liner shall be even and uniform with a troweled, brushed, or natural finish.
7.1.3 Not all manufacturers recommend the use of a protective coating over the cementitious liner material. If the liner is to receive a top coating, then an anchor tooth finish is recommended and shall be free of curing or similar compounds. For dry gunite applications, finish in accordance with ACI 506R, using the recommended trowel.
7.1.4 Apply the prepackaged cementitious liner material from the top of the manhole down to the bench. Overlay the bench with a gradual slope from the wall to the edge of the channel. The wall and bench intersection should have a rounded and uniform radius. The thickness of the bench shall be no less than ½ in. (1.25 cm) at the edge of the channel and shall increase in the direction of the wall so as to provide the required slope.
7.2 *Spray Application—Centrifugal Process*:
7.2.1 Position the high-speed, bi-directional, rotating applicator within the center of the manhole at the lowest point
desired for the new wall and commence pumping the mixed prepackaged cementitious liner material. Man-entry may be required to assure the lining has been effectively applied, as on the underside of any brickwork or around laterals. As the cementitious liner material begins to be centrifugally cast evenly around the interior, retrieve the applicator head at the prescribed speed for applying the thickness that has been selected. Controlled multiple passes in both clockwise and counterclockwise directions are made until the desired thickness is attained.
7.2.2 If the procedure is interrupted for any reason, simply arrest the retrieval of the applicator head until flows are recommenced. Verify the desired thickness with a wet gage. The liners shall be even and uniform with a brushed or natural finish. If the liner is to receive a top coating refer to 7.1.3.
Benches and channels are finished by hand as in 7.1.4.

Quality Assurance

Since the nozzleman is a key element to quality in the shotcrete process the applicator performing this work must hold an **ACI Nozzleman Certfication** and be an employee at the applicator firm. The name and certification ID must be submitted at the time of bid. Applicator shall also present **OSHA confined space** credentials at the time of the bid. Credentials, qualifications, and all applicable certifications must also be submitted at the time of the bid in order to qualify the applicator as capable to perform this scope of work. The stated quality assurance requirements described above are obtainable to anyone and help protect the owner from faulty craftsmanship from unqualified firms who do not meet these requirements.

Reference

ACI: American Concrete Institute
ASA: American Shotcrete Association
NASSCO: National Association of Sewer Service Companies
SSPC: The Society for Protective Coatings
NACE: National Association of Corrosion Engineers

NACE News : Rebuilding Infrastructure Through Better Decisions

A roadmap to help federal, state, and local officials tackle infrastructure corrosion is currently in place. But the process for implementing this model is very different from the framework the U.S. Department of Defense (DoD) uses to fight corrosion on our military weapon systems.

Daniel J. Dunmire, Director, DoD Office of Corrosion Policy and Oversight

When I speak of infrastructure, I refer to our highways, roads, and bridges, as well as our pipeline, utility, and wastewater systems. By now, members of NACE International are familiar with the seminal NACE-sponsored study, which estimates that corrosion of this infrastructure directly costs the United States $276 billion annually. Moreover, we should understand that within the myriad agencies comprising the U.S. DoD, U.S. Department of Transportation, and our federal, state, and local governments, there is no central process or mechanism for curbing the cost of mitigating infrastructure corrosion. Nonetheless, it is paramount that we follow certain corrosion prevention and mitigation protocols as we repair and rebuild our aging infrastructure.

First and foremost, potential corrosion concerns must be addressed as new systems are being designed, based on the availability of resources. At first blush, this is easier said than done because the system designers and decision-makers don't fall under the auspices of a single entity. Our first key challenge is to educate the decision-makers within DoD, local municipalities, cities, and state governments, and to make them aware that there are corrosion challenges to be considered in the design of our bridges, roads, water and sewer systems, and military installations.

Second, coordination among policy-makers, engineers, and contractors is paramount so the best possible coatings, metals, and cathodic protection (CP) systems are used. Decision-makers should ensure that subject matter experts select materials that are appropriate and properly employed. Organizations such as NACE, above all, can lead the way toward our meeting this challenge by forming public and private partnerships and engaging state and local governments to address corrosion in the design phase at the federal, state, and county level.

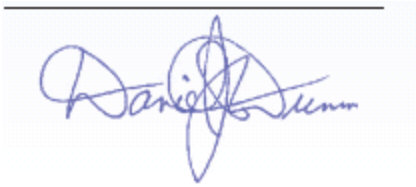
If you examine any of our DoD-approved CP technologies reviewed by the Government Accountability Office, you'll find that the return on investment (ROI) is worth every cent expended by taxpayers, because they ensure that the life of our military installations are prolonged for as long as possible.

DoD has a model in place for tackling infrastructure corrosion. This model can and must be adapted and transferred to the executive branch, states, counties, and municipalities. This framework consists of DoD instructions, corrosion prevention projects with a high ROI, guidebooks and technical handbooks, and myriad collaborative efforts among DoD, industry, and academia. We need public administrators and subject matter experts to adopt the DoD model and adapt it to their own needs and requirements.

Finally, I should point out that corrosion is not the most important issue that must be considered in preserving infrastructure. The DoD Corrosion Office recognizes that important trade-offs must often be

made at the design level. But corrosion must be appropriately considered because we cannot afford to ignore it anymore.

The DoD models for tackling infrastructure corrosion can be found at the CorrDefense Web site at www.corrdefense.org.



Reference list in regards to products and methods for rehabilitation and protective coatings for Wastewater Systems

http://www.nace.org/content.cfm?parentid=1671&currentID=1751

http://www.southerntrenchless.com/documents/Manhole-Mortar-Product-Sheet-ver.6.11.pdf

http://www.ttc.latech.edu/publications/other/manhole.availableproducts.pdf

http://www.southerntrenchless.com/documents/ASTM_F_2551-09_Cement_Liner.pdf

http://www.trenchlessonline.com/index/webapp-stories-action?id=1748

http://msds.carboline.com/website/carbmsds.nsf/(all)/442C8F294F076EE08525705A00434C60/$file/Plasite+4500+S+PDS+9-09.pdf

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http://www.trenchlessonline.com/index/webapp-stories-action?id=1748

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These are solid industry resources, specifications, and typical product data specs for cementitious structural repair lines and epoxy protective coatings.