SECTION 33 01 30.63

SEWERAGE SYSTEM MORTAR REHABILITATION

PART 1 – GENERAL

1.01 CALCIUM ALUMINATE CEMENTITIOUS STRUCTURAL REHABILITATION COATING

This specification defines the method and material for the rehabilitation of sanitary manhole utilizing a spray applied calcium aluminate cementitious (CAC) structural rehabilitation system. The purpose of this work is to obtain a dense and durable concrete mortaring that is resistant to biosulfuric acid attack and meets the strength requirements described elsewhere in this specification.

1.02 DESCRIPTION

A. The work specified in this Section shall include:

1. Eliminating voids in walls.
2. Properly preparing interior to produce a surface suitable for application and adhesion of the specified coating system.
3. Bypassing main sewer flow as necessary.
4. Rehabilitate all interior surfaces of manholes and sewers in accordance with specifications.
5. Testing of CAC mortar material.
6. Furnishing all labor, equipment, materials, and supervision necessary to accomplish the rehabilitation as specified.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Other contract documents, including Drawings, Relevant Sections of the SFDPW Standard Specifications and these Specifications apply to work specified herein.

B. Division 1, General Requirements.

C. Sections 33 33 00.

1.04 REFERENCES

A. Department of Public Works Standard Specifications dated November 2000.

B. Standard Specifications for Public Works Construction - 1991 Edition (“Green Book”).

C. American Society of Testing and Materials (ASTM) Standards. (Latest Edition).

1.05 SUBMITTALS

A. The Contractor shall provide six (6) copies of the following:

1. Manufacturer’s product data, including physical properties, surface preparation, repairs, application and curing instructions, Material Safety Data Sheets (MSDS/SDS), and field quality control.
2. Manufacturer’s product data and MSDS/SDS for repair, resurfacing and

infiltration control materials, if necessary, and proof of compatibility of the materials.

3. Independent laboratory reports proving performance properties of mortar material.

4. Manufacturer's warranty and warranty application procedures.

5. Nozzle men and applicator's certification from the coating manufacturer, applicator and foreman reference and contact information on recently completed manhole rehabilitation using this coating within the last three (3) years.

PART 2 – PRODUCTS

2.01 MATERIALS FOR CAC MORTAR

A. Mortar material furnished under this specification shall be a prepackaged mortar mix, including all cement, aggregates, and any required additives. It is the intent of this specification that the Contractor only be required to add the proper amount of potable water so as to produce concrete suitable for spray application. Do not add portland cement, other aggregates, or any admixtures whatsoever to mortar material. Typical package weights shall not be less than 50 lbs and shall be identical for all material furnished on this project.

B. The chemical composition of the cement portion as well as the aggregates of the mortar mix shall be as follows:

Al_2O_3	CaO	$FeO + Fe_2O_3$	SiO_2
39-44%	35-39%	9-14%	5-7%

C. The properties of the mortar mix are typically as follows:

Property	ASTM Test	Result
Compressive Strength	ASTM C109-92	
1 Day		5,500 psi
7 Days		6,000 psi
28 Days		7,000 psi
Flexural Strength	ASTM C78-84	
1 Day		900 psi
7 Days		1,100 psi
28 Days		1,300 psi
Slant Shear Bond Strength	ASTM C882-91 Modified	
7 Days		2,500 psi
28 Days		2,500 psi
Splitting Tensile Strength	ASTM C496-90	
1 Day		550 psi
7 Days		600 psi
28 Days		700 psi
Shrinkage	ASTM C596	< 0.08% cured @ 90% relative humidity

D. Mortar mix must have at least seven (7) years of successful performance in similar applications and be supplied by an ISO 9001 certified manufacturer.

E. Mortar mix shall be designed to withstand long-term exposure to a bacterially corrosive hydrogen sulfide environment that may be expected to produce a pH of 1 on normal Portland cement based concrete or typical brick and mortar surfaces.

F. Water used in mixing shall be fresh, clean, potable water, free from injurious amounts of oil, acid, alkali, vegetable, sewage and/or organic matter.

2.02 MATERIALS FOR REPAIR AND INFILTRATION CONTROL

A. A rapid setting crystalline enhanced hydraulic cement product specifically formulated for infiltration control shall be used to stop minor infiltration flows in accordance with the manufacturer's recommendations. The material shall meet the following strength requirements:

Compressive Strength (ASTM C597B)	600 psi 1,000 psi	(24 hours) (7 days)
Bond Strength (ASTM C321)	30 psi 80 psi	(1 hour) (1 day)

B. All materials, labor, equipment, and incidentals required to correct inflow and infiltration conditions will be considered incidental to rehabilitation.

PART 3 – EXECUTION

3.01 SAMPLING AND TESTING

A. City's material testing lab shall sample and test the material used on the project. When City's material testing lab is unavailable, a recognized independent testing laboratory shall be hired to test the material.

B. Four (4) two-inch cubes of CAC mortar shall be cast each day or from each of two (2) pallets as selected by the City Representative, and shall be tested from compressive strength per ASTM C109. One (1) of these samples shall be tested at 24 hours and the remaining 7 samples shall be tested at 28 days. The CAC mortar shall meet the compressive strength as defined in section 2.01.

C. Other testing required showing conformance with these specifications shall be the responsibility of the Contractor. Certified test reports and certificates, when so directed, shall be submitted in duplicate to the City Representative.

3.02 QUALIFICATIONS

A. The applicator shall be certified by the CAC coating system manufacturer.

B. The nozzle operator and foreman shall have a minimum of three (3) years' experience each installing the coating system for similar work and project conditions.

C. Either the foreman or nozzle operator shall be on-site during all preparation and installation activities.

3.03 EQUIPMENT

Equipment shall be of spray type and approved by the material manufacturer. Alternate equipment may be utilized provided it meets the performance requirements of the specification.

All equipment must be kept in operating condition and good repair.

3.04 SURFACE PREPARATION

A. Prior to the installation of the mortar coating, the host sewer surfaces shall be prepared to produce a surface suitable for application and adhesion of the CAC mortar material. Contractor shall ensure the surfaces are clean and free of laitance, loose material, residue and all existing coating and mortaring materials. The Contractor shall thoroughly clean all the surfaces to be coated to remove grease, sludge, direct, magnesium hydroxide, other foreign deposits, and all deleterious materials that may affect the bonding of the mortar. Root shall be removed.

B. Cleaning and surface preparation shall include the inspection of the existing structure for damage and infiltration. The Contractor shall protect the host structure from damage due to cleaning, and any damage shall be repaired prior to installation of CAC mortar coating.

C. Prior to coating installation, patching, localized repairs, and resurfacing shall be performance in accordance with the coating manufacturer's recommendations. Repair, resurfacing and material to eliminate active infiltration shall be compatible with the CAC mortar material and shall meet specifications as specified in section 2.02.

D. Sub-surfaces shall be thoroughly saturated with water prior to the application of the mortar materials. In no instance shall shotcrete be applied in an area where running water exists.

3.05 INSTALLATION

A. The coating shall be installed in accordance with the manufacturer's recommendations.

B. The Contractor shall provide all equipment necessary to individually gauge, control, and monitor the actual amounts of all component materials necessary to complete the mortar installation.

C. All CAC mortar materials shall be thoroughly mixed by mechanical means to ensure all agglomerated particles are reduced to original size or removed prior to placement into the application equipment (i.e. the hopper). Each batch of material should be entirely discharged before recharging with fresh material. Mixing equipment shall be cleaned at regular intervals to remove all adherent materials.

D. The addition of water to the mix shall be in strict accordance with the Manufacturer's recommendations.

E. Re-mixing or tempering shall not be permitted. Rebound materials shall not be reused.

F. CAC mortar material shall not be applied to a frozen surface or to a surface that may freeze within 12 hours of application. Frozen conditions shall be defined as ambient temperatures of 40 degrees Fahrenheit or below.

G. Sequence of application may be from bottom to top or vice versa if rebound is properly removed.

H. Application shall be from an angle as nearly perpendicular to the surface as practicable, with the nozzle held at least 1 foot from the working sub-surface (except in confined control). If the flow of material at the nozzle is not uniform and slugs, sand spots, or wet sloughs result, the nozzle operator shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.

Application shall be suspended if:

1. Air velocity separates the cement from the aggregate at the nozzle.

2. Ambient temperature approaches freezing and the newly placed material cannot be protected and insulated.

I. The time interval between successive layers of material application must be sufficient to allow “tackiness” to develop but not final set.

J. Construction joints within a manhole shall be avoided. In the event a construction joint is necessary and approved by the City Representative, it shall be sloped off to a thin, clean, regular edge, at a 45-degree angle. Prior to placement of the adjoining materials, the sloped portion and adjacent applied material shall be thoroughly cleaned as necessary, then moistened and scoured with an air jet.

K. Nozzle operator shall bring the material to an even plane and to well-formed corners.

L. After the body coat has been placed, the surface shall be trued with a thin-edge screed to remove high areas and expose low areas. Low areas shall be properly filled with additional material to insure a true, flat surface.

M. The minimum thickness of CAC mortar shall be a 1-inch cover over all surfaces. Refer to Section 3.08 for thickness verification.

N. At the pipe interface with the manhole, the CAC shall be placed up to the leading edge of the pipe and flush with the inside diameter of the pipe surface.

O. When mortaring manhole only, CAC shall not be sprayed into any existing pipes. If CAC does enter a pipe, the Contractor shall remove all CAC from the pipe.

P. CAC coating shall be tapered as to not create an abrupt angle, where applicable.

3.06 CURING

A. If the material has been applied and furnished in accordance to the specifications, and it has been determined that the environment is not moist enough for natural curing, the contractor will be required to apply a curing compound to all coated surfaces. Curing compound shall meet the requirements of ASTM C309 and have the approval of the CAC material Manufacturer and the City Representative prior to use.

B. Moist curing may also be used in lieu of curing compound. If moist curing is selected, it should be implemented just after the notice of uniform heat generation of the installed mortar. Moist curing can consist of the use of soaker hoses, water sprinklers, or vapor/misting machines. Regardless of delivery method, moist curing should continue for a minimum of 18 hours.

3.07 PROTECTION OF ADJACENT SURFACES

A. During progress of the work, adjacent areas or grounds which may be permanently discolored, stained or otherwise damaged by dust and rebound material, shall be adequately protected and, if contacted, shall be cleaned by early scraping, brushing or washing as the surroundings permit.

3.08 THICKNESS VERIFICATION

A. In order to verify that the dry coating thickness meets the minimum requirement, the Contractor shall core the CAC coating at three (3) locations at each manhole or at each pipe segment at locations selected by and as directed by the City Representative. The testing locations shall be determined by the City Representative after rehabilitation work is complete. The core holes shall be repaired in accordance with the manufacturer’s recommendations. The average thickness of samples shall be calculated separately, and shall be equal to or greater than the minimum coating thickness as specified, and if it is not, then the manhole shall have the surface prepared per the manufacturer’s recommendation and additional coating shall be applied, at no additional cost to the City. If this thickness test fails, then core samples and repair may be required at additional locations to verify coating thickness.

3.09 CLEAN UP

A. Upon completion of the installation work and after required testing indicates the manhole is acceptable, Contractor shall restore the project area affected by his operation.

3.10 CORRECTION OF DEFECTS IN SEWER CONSTRUCTED IN THIS CONTRACT

A. The City will inspect the work prior to expiration of the three year post-construction period, following the date of acceptance of the work.

B. All defects shall be corrected by the Contractor at no expense to the City.

END OF SECTION