WASTEWATER RECLAMATION
SOLID WASTE MANAGEMENT

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

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CHARLES W. CARRY
Chief Engineer and General Manager

July 7, 1993

RECEIVED
JUL 12 1993
J. A. CRAWFORD CO.

Mr. Michael B. Keating
J. A. Crawford Company
P.O. Box 1473
Whittier, California 90609

Dear Mr. Keating:

<u>Evaluation of Sauereisen-210 Coating System for Concrete Protective Characteristics</u>

Sauereisen Cements Sauereisen-210 epoxy coating system was evaluated for its concrete protective characteristics in the Districts Concrete Coating and Liner Testing facilities in Compton for approximately one year of acid service. The coating system was well bonded to the concrete substrate. No indication of corrosion to the liner or the underlying concrete was observed.

As a result of this evaluation, Sauereisen Cements Sauereisen-210 epoxy coating system will be included as an alternative coating product in specifications that we prepare in the future for concrete coating systems. Information contained in this letter is not for publication or advertisement. No endorsement is intended for this coating system. Prior written approval of the Sanitation Districts is required for any advertisement or promotion that involves this agency.

Thank you for your continued cooperation and interest in the Districts' evaluation program for concrete coatings. If you have any questions or need additional information, please contact Edward Esfandi at (310) 638-1161 ext. 222.

Very truly yours

Charles W. Carry

E. J. Esfandi

Edward J. Esfandi
Senior Engineer

EE:sj

Can coatings protect wastewater treatment systems?

County Sanitation Districts of Los Angeles County tests the sulfuric-acid resistance of 78 products

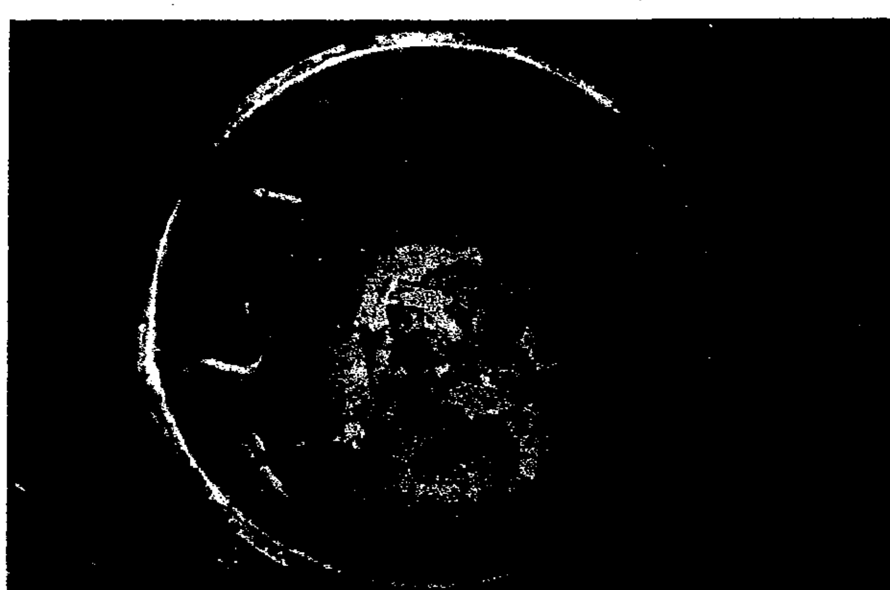
BY MARTIN S. MCGOVERN

"*Few, if any, coatings have been effective in preventing the deterioration of concrete under highly corrosive conditions.*" So says the Water Environment Federation's 1969 Manual of Practice No. 17, *Paints and Protective Coatings for Wastewater Treatment Facilities.* "Highly corrosive conditions" refers to sulfuric acid, which is secreted by bacteria as it consumes hydrogen sulfide and other sulfur-containing chemicals found in raw sewage.

Sulfuric-acid attack is responsible for billions of dollars of damage to concrete wastewater collection and treatment systems throughout the United States. "However, many agencies are unaware of the significant deterioration occurring to their concrete facilities," says John Redner, sewerage system manager for the County Sanitation Districts (CSD) of Los Angeles County.

Over the past 15 years, manufacturers have developed numerous high-solids, fast-curing coating systems that they claim will resist sulfuric acid in sewers and wastewater treatment plants. Manufacturers spend much time and money evaluating protective coatings in the lab, but field results have varied greatly. One agency reports nothing but success, while another reports nothing but failure.

The only successful method CSD has found for resisting sulfuric acid is to install polyvinyl-chloride liners to concrete surfaces during construction. However, many rehabilitation



Photos by County Sanitation Districts of Los Angeles County

Many coatings, such as this epoxy, have not fared well in the aggressive conditions found in wastewater treatment systems.

projects do not allow enough downtime for concrete surface repairs and installation of the liners. The ideal solution, CSD reasoned, would be to find a coating system that bonds to concrete and resists sulfuric acid.

So in 1983, CSD launched a testing program simulating actual field conditions to identify coating systems that would bond strongly to concrete and provide the required sulfuric-acid resistance. To date, they have tested 78 different protective systems.

Preparing the test specimens

To simulate actual conditions, the evaluations were conducted in shallow concrete tanks constructed by inserting two concentric, precast, reinforced-concrete manhole shafts into a freshly poured concrete base slab (Fig. 1). The annular space between the outer and inner tank was filled with water to simulate moisture from groundwater or from an adjacent process unit.

The lower half of each tank was filled with a 10% solution of sulfuric acid and subjected to the acid attack for 6 to 8 weeks. During this time, the unprotected tanks deteriorated

The survivors

Of the 27 coatings to successfully complete 1 year of evaluation, the 18 products listed below are still available.

Manufacturer	Product	Generic type
Madewell Products Corp.	Mainstay DS-4	Coal-tar mortar
Master Builders Inc.	Concresive 1305*	Epoxy coating
Con-Tech of California	Con-Tech Hydro-Pox	Epoxy coating
Sentry Polymers Inc.	Semstone 140S	Epoxy mortar
Belzona Inc.	Maga Quartz	Epoxy mortar
Integrated Polymer Industries Inc.	I.P.I. Crystal Quartz	Epoxy mortar
Sauereisen	Sauereisen 210	Epoxy mortar
Raven Lining Systems	Raven 405	Epoxy mortar
Linabond Inc.	Linabond Mastic System	Liner
Danby of North America	Danby PVC Liner	Liner
Linabond Inc.	Linabond Structural Polymer System	Liner
Sun Coast Environmental Intl. Inc.	Poly-Triplex Liner	Liner
Polymorphic Polymers Corp.	PPC Coatings	Polyester mortar
Integrated Environmental Technologies	I.E.T. System 3	Polyester mortar
Willamette Valley Co.	Polyquick P300	Polyurea
National Chempruf Concrete	Chempruf	Sulfur concrete
ECT Inc.	ICOM	Polymer concrete
Tnemec Co. Inc.	120 Vinester	Vinyl-ester mortar

* No longer available. Closest related product is Mastertop 1663.

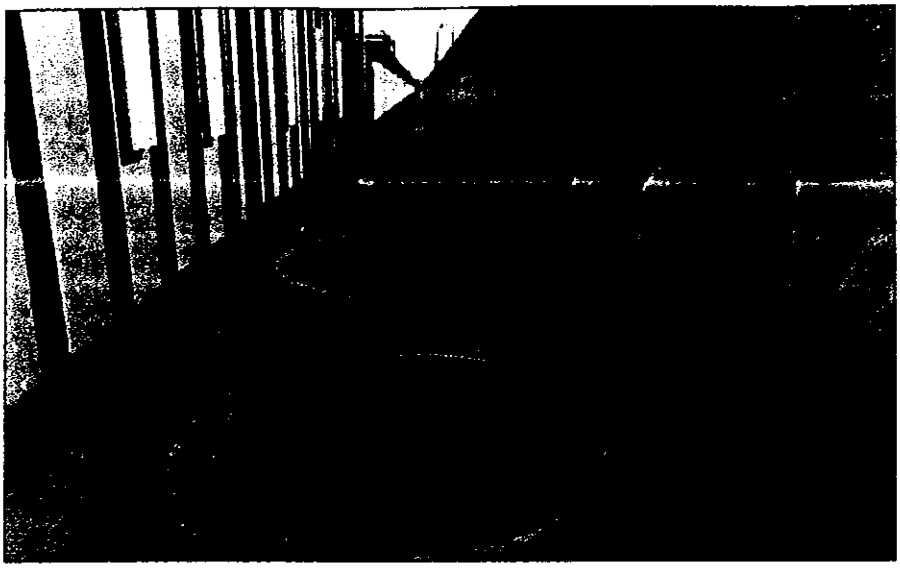


Figure 1. To simulate actual conditions, the evaluations were conducted in shallow concrete tanks constructed by inserting two concentric, precast, reinforced-concrete manhole shafts into a freshly poured concrete base slab.

to a depth of about 1 inch. The use of 10% acid was arbitrary but represented a more aggressive environment than actual service conditions.

Coatings were applied to the test tanks when sufficient aggregate and even some reinforcing steel was exposed. The manufacturer was asked to apply the coating to both the corroded and uncorroded surfaces inside the test tank within 8 hours. The coating manufacturer was responsible for all surface preparation before applying the coating. Generally, the manufacturers chose either sandblasting or high-pressure waterblasting for surface preparation. If too much aggregate was exposed for proper application of the coating, the manufacturer was responsible for surface repair as well. Most surface repairs used fast-curing concrete or a mixture of the coating material and a sand filler.

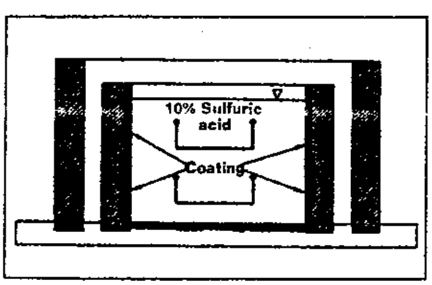


Figure 2. Coating systems were applied to both the deteriorated bottom portions of the tanks and to the undeteriorated top portions. The applied coatings were then subjected to a 10% solution of sulfuric acid.

The coatings tested had to cure sufficiently so water could be added to the test tank within 48 hours of application. Ninety-six hours after application, concentrated sulfuric acid was added to the test tanks to achieve a concentration of 10%. The acid solution exposed both the deteriorated and undeteriorated coated surfaces (Fig. 2).

Manufacturers were not allowed to perform any pinhole or holiday testing after applying the coatings, even though such testing is part of a standard application specification. Any coating system that could not be applied on such a small scale by the manufacturer without this type of failure was not considered a viable system.

Evaluation

The coatings were evaluated for at least a year. Unless coating failure was observed earlier, the acid solution was usually removed every 3 months to allow for a physical inspection of the tanks. During the inspection, photographs were taken to document any changes in the coating's protective characteristics or appearance. The bonding quality was observed, and the coating thickness was measured. A cross section of the coating was inspected to evaluate pinholing, air pockets, or any gradual deterioration or reaction with the acid. The manufacturers were given the opportunity to repair any areas damaged by the inspection. Successful coating systems were tested beyond 1 year to obtain additional information on long-term performance.

For each coating system, the time to failure (or completion of the test) was recorded. The coatings' ease of application, acid resistance, and bonding characteristics were also rated on a scale of one to four, with a score of one being the best. The three scores were then added to produce a cumulative score.

Of the 78 coatings tested, only 27 successfully completed 1 year of evaluation (see table). All of these coatings had a cumulative score of five or less. The highest survival rate belonged to the mortar systems, regardless of whether the coating resin was a coal-tar epoxy, epoxy, polyester, or vinyl ester. The next highest survival rate belonged to the liner category. The neat epoxy survival rate was 25%. The survival rates for the specialty concrete and urethane categories were 23% and 12%, respectively. The neat coal tar, neat polyester, and neat vinyl-ester coating systems all failed. The only neat systems to survive the evaluation were the polyurea and two out of 16 urethane systems. The overall survival rate for all coating systems was 35%.

Reference

John A. Redner, Randolph P. Hsi, Edward J. Esfandi and Roger Sydney, "Evaluation of Protective Coatings for Concrete," County Sanitation Districts of Los Angeles County, Whittier, Calif., August 1998.