ConShield MIC Technologies, Inc.
biotech armor for concrete

St. Louis MSD Maline Drop Shaft Long Term Testing

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Figure 1 View of the Maline Drop Shaft from the ground

Figure 2 Confined Space Entry Staging

1. Situation Background

The Maline Drop Shaft, located near the Chain of Rocks Bridge, is just like concrete sewer structures everywhere. They corrode when hydrogen sulfide gas is present. Moderately-high temperatures, long retention times, high biological oxygen demand (BOD) levels, and turbulence contribute to elevated levels of hydrogen sulfide gas which, in turn, provide the food for acid-producing bacteria. The technical name for this process is Microbiologically Induced Corrosion (MIC). This 40-year-old concrete structure was severely deteriorated from MIC. The upper portion of the walls were mushy with more than two inches of the original wall missing; in the lower half of this 50-foot-deep structure, more than five inches of the walls had corroded away.

Figure 3 Corrosion prior to repair in 1999

Figure 4 Reinforcing steel exposed after pressure washing

2. Structural Restoration

In 1999, St. Louis MSD chose Specialty Sewer Company, now ADS Environmental Services, a licensed Permacast® applicator in the St. Louis area, to provide the quickest and most cost-effective method to restore the structural integrity of this severely-corroded structure and to prevent future corrosion. Specialty Sewer Company partnered with Spray-Com, another licensed Permacast® applicator with extensive experience in deep structures, on the project. A crew of five worked for 32 days and did the following to restore the structure:

- Power washed the walls back to solid material
- Attached wire mesh to the walls for structural reinforcement of the worst areas
- Applied MS-10,000, a cementitious grout fortified with Con^{mic}Shield®, in one inch lifts
- Troweled the surface after each layer was applied to ensure a densely-compacted, uniform finish
- Troweled smooth a final one-inch layer once the entire wall was rebuilt to the plumb line

Upon completion of the job, the structural integrity of the Maline Drop Shaft was restored to a better than new condition. Thanks to the addition of Con^{mic}Shield® to the MS-10,000 repair grout, the drop shaft is permanently protected from future MIC damage. The Con^{mic}Shield® additive kills the sulfuric acid-producing bacteria; and, since it is molecularly bonded to the cementitious repair grout, it cannot wash off, chip off, delaminate, or pinhole.

Annual inspections since the restoration of the Maline Drop Shaft were completed, revealing that corrosion has stopped. After eight years, only 3/32" of the wall had been lost to abrasion or erosion. This quick and cost-efficient solution to the MIC damage in the Maline Drop Shaft has greatly extended its life in spite of the continued unstoppable and highly-turbulent flows and extremely-high levels of hydrogen sulfide gas.

3. Ten-year Inspection

In 2009, MSD conducted a 10-year inspection of the pilot restoration program of the Maline Drop Shaft. The inspectors concluded the restoration project successfully protected the structure from MIC and added Con^{mic}Shield® to the approved specification for structural construction projects in the District.

Figure 5 Photo of the shaft looking down during the 2009 inspection

Core samples were taken in 2010 to verify the efficacy of Con^{mic}Shield® in the MS-10,000 lining. See figure 6 below.

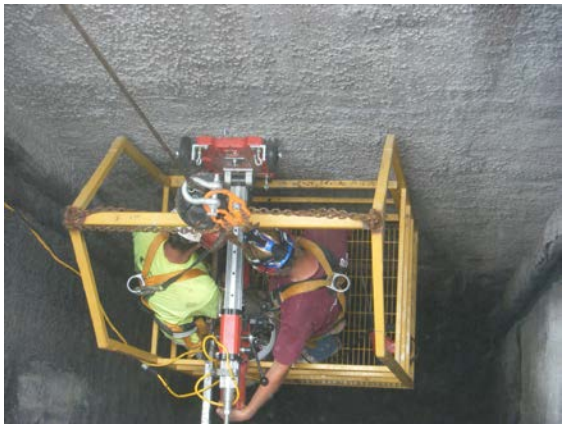

Figure 6 Photo of the core sample being taken in 2010

The photo of the core sample in Figure 7 shows two pieces. The large piece was labeled Maaline 62910 large section and is a portion of the original concrete substrate. The smaller piece is MS-10,000 fortified with Con^{mic}Shield® and was labeled Maaline 62910 small section. See figure 8 below showing no bacterial growth from the MS-10,000 fortified with Con^{mic}Shield®. These samples were submitted to Microbac for testing in July of 2010. See attached Microbac test report.

Figure 7 Photo of the core sample

Figure 8 Photo of the agar plate showing no bacteria growth

4. Implementation into St. Louis MSD Specifications

Following the 10-year inspection, the St. Louis MSD inspectors concluded the restoration project successfully protected the structure from MIC and added Con^{mic}Shield® to the approved specification for structural construction projects in the District. St. Louis MSD subsequently began to routinely use Con^{mic}Shield® in manhole and pipe projects. MS-10,000 fortified with Con^{mic}Shield® were also added to the approved list of rehabilitation materials.

St. Louis MSD requires that concrete products containing Con^{mic}Shield® be tested prior to installation as part of their QA/QC program. The process confirms that Con^{mic}Shield® is in place and working. See attached Situ Biosciences, LLC report.

5. 2015: Sixteen-year Inspection

The shaft was again inspected, by St. Louis MSD and engineers from the City of Newburgh, IN in 2015 to further determine the viability of Con^{mic}Shield®'s effectiveness. The mortar and Con^{mic}Shield® were found to have performed above and beyond expectations.

6. Third-Party Test Reports

a. Microbac, August 2010

3 pages to follow

TEST REPORT

CLIENT:

ConShield Technologies Inc.
541 Tenth Street NW #233
Atlanta, GA 30318-5713

Attn: Joe Cherry

OBJECTIVE: To test for the presence of ConShield in concrete samples.

SAMPLES: Two samples were delivered by the client on July 13, 2010 and identified as follows:

1. Maaline 62910 small section
2. Maaline 62910 large section

TESTING: The samples were analyzed according to ConShield's protocol, a modified ASTM D4783 procedure.

The concrete samples were washed with water, dried, and then place in a carbon dioxide chamber overnight**.**

A cell suspension of *Serratia marcescens* was prepared using distilled water, estimated at 1×10^7 cfu/ml. Approximately 0.2-0.3 ml of the cell suspension was placed on the sample surface and allowed to dry. The samples were then placed in a closed container with moist paper towels and incubated for 24 hours at 30 ± 1°C.

For cell recovery, 0.2-0.3 ml of sterile water was washed over the surface of the sample, stirred with a pipette, then removed and plated on nutrient agar. Additionally, a sterile cotton swab was brushed over the surface of the sample and then used to streak another nutrient agar plate. Both plates were incubated for 48 hours at 30 ± 1°C.

RESULTS: After 48 hours of incubation, sample 1 had no growth indicating the presence of ConShield. Sample 2 had some pink colonies, indicating no ConShield was present.

Digital images of the samples and nutrient agar plates are presented in Figures 1 through 4 for additional information.

CLIENT:

ConShield Technologies Inc.
541 Tenth Street NW #233
Atlanta, GA 30318-5713

Attn: Joe Cherry

Small section

Nutrient agar plate from small section

CLIENT:

ConShield Technologies Inc.
541 Tenth Street NW #233
Atlanta, GA 30318-5713

Attn: Joe Cherry

Large Section

Nutrient agar plate from large section

DATA REVIEWED AND REPORT WRITTEN BY:

Becky F. Kinsinger
Microbiology Manager

REPORT REVIEWED BY:

Angelica Tovar
Project Coordinator

6. Third-Party Test Reports

b. Situ Biosciences, January 2011

3 pages to follow

Monday, January 17, 2011

SiTU Biosciences LLC

Customer Report

Situ Biosciences LLC
3415 Howard St, STE 102
1-847-677-4575
Info@situbiosciences.com

Customer Report Summary

Contact	Carlos Huddleston, P.E.; Gonzalez Companies LLC
Project Title	Bacterial inhibitory performance of treated concrete
Project ID#	1110ADA0101

Overview:

Seven concrete samples treated with antimicrobial additives were submitted for microbiological testing to determine the performance of the antimicrobial product against a range of *Thiobacillus species*. For the purpose of the test, three *Thiobacillus species* were selected based on their ability to accommodate the surface of native concreted that has been aged using a rain water mist cycling protocol. The mist cycling reduced the inherent concrete pH from ~ 10.5 to a pH of 6.8 in 21 days using a solution of rain water salt solution at a pH of 5.4.

As environmentally isolated *Thiobacillus* bacteria cover a broad range of organism types that will both thrive and reduce pH to as low as pH 1, the Thiobacillus inoculum selected contains *Thiobacillus sp.* that can grow in a range of pH conditions from pH 6 to <pH 4.

Results: Each of the tested samples demonstrated an approximate 1.5 to 3 log reduction during the course of the testing.

Conclusion: The pH neutralized concrete samples show clear antibacterial activity against a range of *Thiobacillus* bacteria.

d p satchell

Don P. Satchell Ph. D.
Situ Biosciences LLC, Technology Director

SiTU Biosciences LLC

Customer Report

Monday, January 17, 2011

3415 Howard St. STE 102
Skokie, IL 60076
1-847-677-4575
Info@situbiosciences.com

Contact Gonzalez Companies LLC Carlos Huddleston, P.E. 618-222-2221

Title Bacterial inhibitory performance of treated concrete

Project ID 1010-ADA-01-- 1 Entry Date 11/4/2010 Test Start Date 12/3/2010

Sample Result Table

Test Method ASTM D4783 - 01(2008) Adapted for determination of antibacterial resistance of concrete to thermobacillus sp.

Sample # 1 90" w/ Stirrups w/Conshield

Inoculum	Interval	Result
Mixed Thiobacillus sp.		
T. intermedia; Reduction >= 99.9%	24 hr	3 Log Reduction
T. novella; Reduction = 99%	24 hr	2 Log Reduction
T. thioparus; Reduction = 99%	24 hr	2 Log Reduction

Sample # 2 48" Risers w/Conshield

Inoculum	Interval	Result
Mixed Thiobacillus sp.		
T. intermedia; Reduction >= 99.9%	24 hr	3 Log Reduction
T. novella; Reduction >= 99.9%	24 hr	3 Log Reduction
T. thioparus; Reduction = 99%	24 hr	2 Log Reduction

Sample # 3 90" CL-5 w/ Stirrups w/Conshield

Inoculum	Interval	Result
Mixed Thiobacillus sp.		
T. intermedia; Reduction >= 99.9%	24 hr	2 Log Reduction
T. novella; Reduction >= 99.9%	24 hr	3 Log Reduction
T. thioparus; Reduction >= 99.9%	24 hr	3 Log Reduction

Sample # 4 9-29 (unlabeled)

Inoculum	Interval	Result
Mixed Thiobacillus sp.		
T. intermedia; Reduction >= 99.9%	24 hr	2 Log Reduction
T. novella; Reduction = 95%	24 hr	2 Log Reduction
T. thioparus; Reduction >= 99.9%	24 hr	3 Log Reduction

Sample Result Table

Sample # 5 10-8

Inoculum	Interval	Result
Mixed Thiobacillus sp.		
T. intermedia; Reduction >= 99.9%	24 hr	3 Log Reduction
T. novella; Reduction = 91%	24 hr	1.2 Log Reduction
T. thioparus; Reduction >= 99.9%	24 hr	3 Log Reduction

Sample # 6 10-12

Inoculum	Interval	Result
Mixed Thiobacillus sp.		
T. intermedia; Reduction = 99%	24 hr	2 Log Reduction
T. novella; Reduction = 95%	24 hr	1.5 Log Reduction
T. thioparus; Reduction = 99%	24 hr	2 Log Reduction

Sample # 7 10-19 (18)

Inoculum	Interval	Result
Mixed Thiobacillus sp.		
T. intermedia; Reduction >= 99.9%	24 hr	3 Log Reduction
T. novella; Reduction >= 99.9%	24 hr	3 Log Reduction
T. thioparus; Reduction >= 99.9%	24 hr	3 Log Reduction