Preventing Microbiolgically Induced Corrosion IN Sanitary Sewers

NEW YORK ENGINEERS WEEK
ALBANY, NY

Concrete Pipe has a long history of use in sanitary applications.

Deterioration of wastewater systems created by the effects of *"Concrete Corrosion"* is causing premature failure of structures resulting in expensive and disruptive repairs.

A Lot Has Changed Over the Years

- Environmental awareness
- Increased population densities
- Fiscal restraint
- Pipe which is more “water tight”
- Ability to see inside a pipe

Over time the effects of Carbon Dioxide (CO_2) and Hydrogen Sulfide (H_2S) in the sewer system's environment lower the pH of the concrete surfaces.

This supports the growth of many strains of bacteria including Thiobacillus

Definition: ***A strictly autotrophic bacterium that oxidizes sulfur and thiosulfate to sulfuric acid.***

This colonization often starts in a matter of months with a white or yellow discolored surface at the water line.

Released H_2S Gas Reacts With the Moisture in the Crown of the Pipe to Form Dilute Acids

- The dilute acids reduce the pH on the surface of the concrete from its normal level of 11 or 12 to pH 7
- Thiobacillus bacteria, which exists at levels of pH 7 or lower metabolize the excess H_2S into H_2SO_4
- Once pH levels drop below >3.0 the H_2SO_4 corrodes the concrete

National Association of Corrosion Engineers

- TPC Publication 3, Fifth Printing 1990
- Sulfur Bacteria, Page 22

- Thiobacillus is the most common sulfur-oxidizing bacteria. This bacteria oxidizes sulfur and sulfide to produce sulfate and sulfuric acid. Corrosion is caused by the sulfuric acid.

Traditionally, efforts to control corrosion of concrete sewers have been directed at 3 links in the corrosion chain:

1. Protective barriers
2. Alternative materials
3. Control gases

Protective Barriers

Alternative Materials

Control Gases

a safe and easy to use liquid additive which molecularly bonds to the concrete for internal corrosion protection

EPA registration 708712-12

Anti – Microbial Liquid Additive
(MIC) Protection
Markets

PreCast Concrete Shapes

Ready Mix - Concrete

Shotcrete – PL 8000 or PL 8000D

Centrifugally Cast (CCCP)
PL 8000

WHAT IS CONSHIELD

- Conshield is a silicone quarternary ammonium salt
- When dosed directly into a concrete mix, Conshield is a highly charged cationic polymer
- When gram positive or gram negative bacteria come in contact with concrete treated with Conshield they receive a biostatic charge that ruptures the bacteria membrane, killing the bacteria

Key Biscayne Manhole
Miami-Dade Water & Sewer Authority
INSTALLED AUGUST 2001

Sample arrived in a wet condition

SEPTEMBER 11, 2008

Dr. Clarence Baugh, PhD President of Research and Applied Technology.

Custom Biological Inc.

Boca Raton, Florida.

US patent #6656919

Decontamination of
Bacillus Anthraces -Anthrax Spores

ASTM D 4783 – 01

Standard Test Methods for Resistance of Adhesive Preparations in Container to Attack by Bacteria, Yeast, and Fungi (modified for concrete)

Surface Preparation

Surface was scraped with a microscope slide to remove a large part of the slime layer and allow access to the concrete.

SAMPLE PREPARATION

Sample was dried by removing the moisture from the container.
Then, sample was cleaned using an alcohol wash and manual brush.

Test Area

The test area was clearly marked.

Indicator Organism
Applied by Swab to the test location

Storage for Test

The test was stored in a humid, moist area.
Wet Towels are used to maintain moisture.
The container is then covered.

5 Hours After Inoculation

The RED lines are growth of the indicator organism

24 Hours after Inoculation

Samples taken by swab 24 hours after inoculation

CONCLUSIONS

1. The specimen from the Miami-Dade test manhole in service since August 2001 was delivered to our lab on September 11, 2008.

2. The surface tested at acidic levels of pH 5 as expected from natural acidic conditions on the slime layer.

3. E. Coli and similar bacteria were growing on the organic surface material on the slime layer.

4. Thiobacillus Thioxidan bacteria were not present because this bacteria will not grow on organic material such as bio-solids.

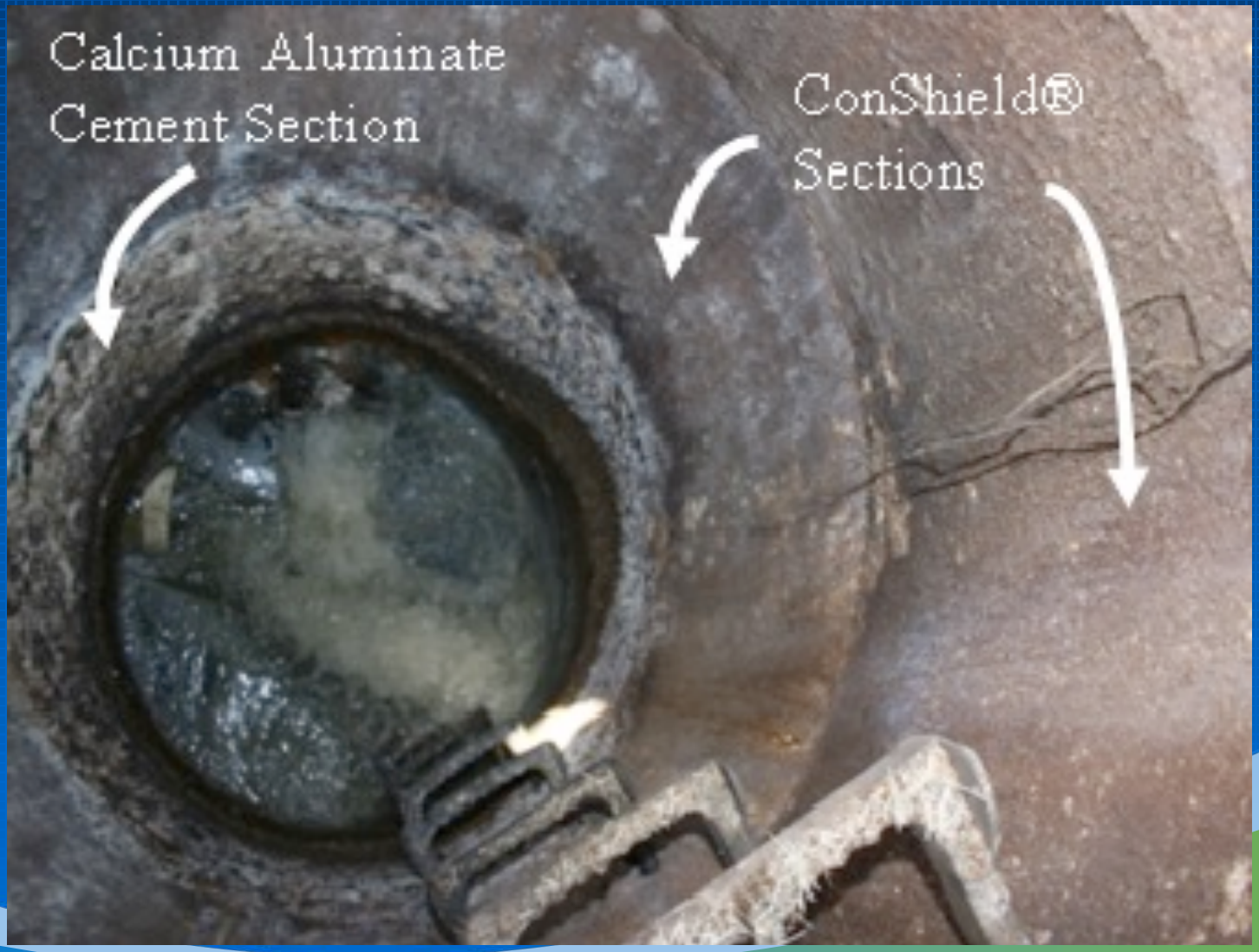
5. The concrete exposed below the slime layer was undamaged.

6. The exposed concrete surface killed the indicator bacteria and therefore tested positive for the presence of Con^{mic}Shield additive.

Clarence L. Baugh, PhD.

Turbulence in manhole in Grand Rapids, Michigan

8 Years in Service, Grand Rapids, MI



CITY OF GRAND RAPIDS, MI AFTER 8 YEARS IN SERVICE

MALINE DROP SHAFT

MALINE DROP SHAFT

MALINE DROP SHAFT:

17 YEARS AFTER CONSHIELD FORTIFICATION

96” Tunnel

ConShield Technologies, Inc.
biotech armor for concrete

Con[mic]Shield® Protection Specified for 96” Concrete Tunnel

Fighting Underground Corruption: The Metropolitan St. Louis Sewer District Turns to an Innovative Anti-microbial Product for a Challenging Concrete Pipe Installation

The Metropolitan St. Louis Sewer District (MSD) faced a problem familiar to many big city wastewater departments managing underground assets. A large (72-inch) sanitary sewer needed to be replaced with an even larger line to handle wet weather flows and eliminate sanitary sewer overflows (SSOs). In the years since initial installation, the above-ground area had become heavily developed.

“We’re handling the Coldwater Creek project in three phases,” explains MSD Principal Engineer Greg Tolcou, P.E., “and this phase is the shortest. It is a 2,300-foot stretch that passes (at an average depth of 20-25 feet to flow line) under Lindbergh Boulevard. It also passes under a 20-inch gas line, a 24-inch water main, a condominium complex lake, the parking lot and the improvements for a driving range. The projected cost to restore surface disruptions is getting so high on these kinds of projects that tunneling is becoming more and more cost effective.”

In fact, tunneling made so much sense on this phase of the project that the bid-winning contractor, SAK Construction LLC, decided to use 96-inch pipe, rather than the specified 90-inch, in order to use a tunnel boring machine (TBM). But choosing the right material for 2,300 feet of very large diameter pipe created its own set of challenges.

Concrete a good choice…

“PVC pipe might have been a good choice, but it’s not available at that size,” says Tolcou, “and fiberglass wouldn’t work at this depth—the extra shoring and bedding required, along with its cost, made it too expensive for this project.”

That left concrete. It could stand the stresses of being jacked in behind the TBM; it didn’t need special shoring or bedding, and it is inherently inexpensive compared to other options. And besides, “St. Louis is a concrete town,” says Tolcou: because the city is on the Mississippi River, and near sources of cement, limestone and sand, concrete pipe makers are easy to find in St. Louis.

That didn’t mean concrete was an easy choice. “There’s a perception about concrete pipe in sanitary sewer applications,” explains Dan Swidrak, P.E., a product engineer at Independent Pipe, which cast the Coldwater Creek pipe, “people worry that the line may corrode.”

Corrosion is a very real problem. Warm

temperatures, turbulence, organic waste, and low oxygen levels common in sanitary sewers create hydrogen sulfide gas and breed aerobic *Thiobacillus* bacteria. In turn, the *Thiobacillus* colonize in the concrete pipe and begin converting hydrogen sulfide into sulfuric acid—some species of *Thiobacillus* have been shown to thrive in sulfuric acid solutions as concentrated as 7 percent, an equivalent pH of 0.5. The acid, of course, attacks the concrete matrix. In the right—or rather, wrong—conditions, microbiologically induced corrosion (MIC) can quickly destroy unprotected pipe.

Fighting MIC is tough. Chemicals like potassium permanganate, chloride, and oxygen can be injected into flows to combat hydrogen sulfide build up, but regular chemical addition is quite expensive. Concrete pipe can also be lined with vinyl but, “It’s

CONSHIELD Technologies Inc. can be contacted at 1-877-543-2094 or info@conshield.com

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ALCHEMY

Spetec

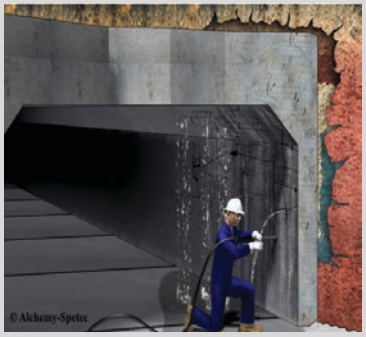
Infrastructure Repair with Chemical Grouts

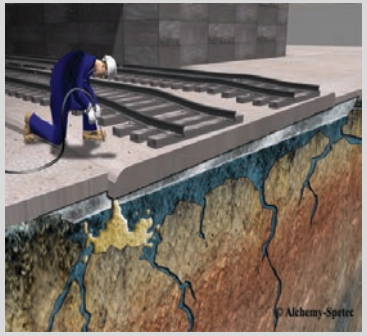
Crack injection

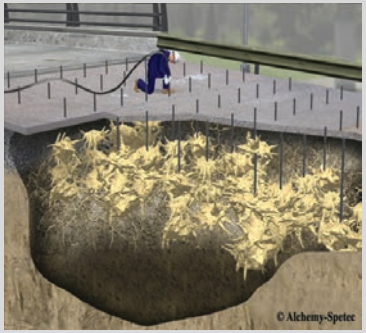
Curtain Wall Grouting

Slab Lifting

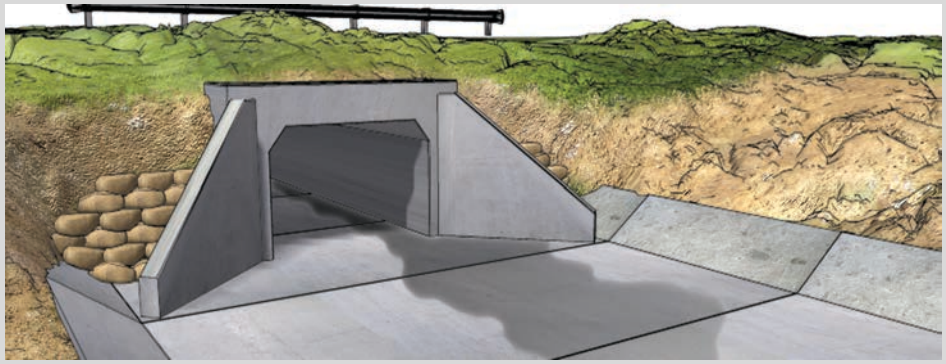
Soil Stabilization

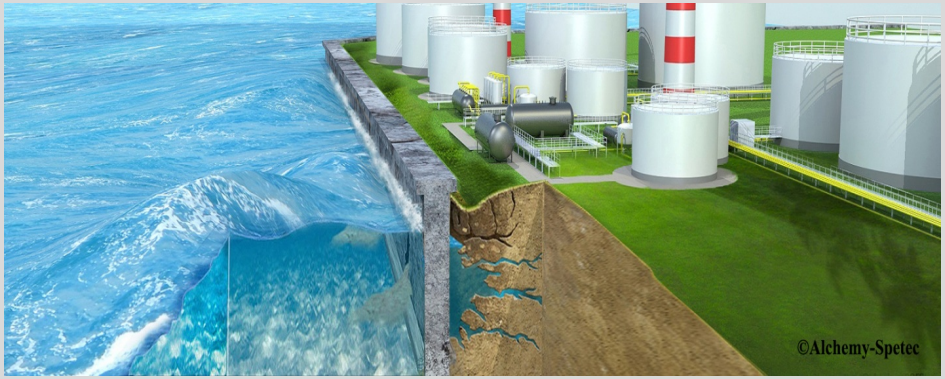






Markets for Chemical Grouts





Hydrophilic vs Hydrophobic

Crack Injection

Injection of cracks in concrete structures has been performed using chemical grouts for over 50 years. These materials react with water and are flexible which allows the cracks to maintain movement.

Advantages Over Other Methods

- Tank can remain in service and full.
- Material reacts with water so unlike epoxy drying the crack is not required.
- Material remains flexible.

Where Do I Start Injecting ?

Vertical cracks:

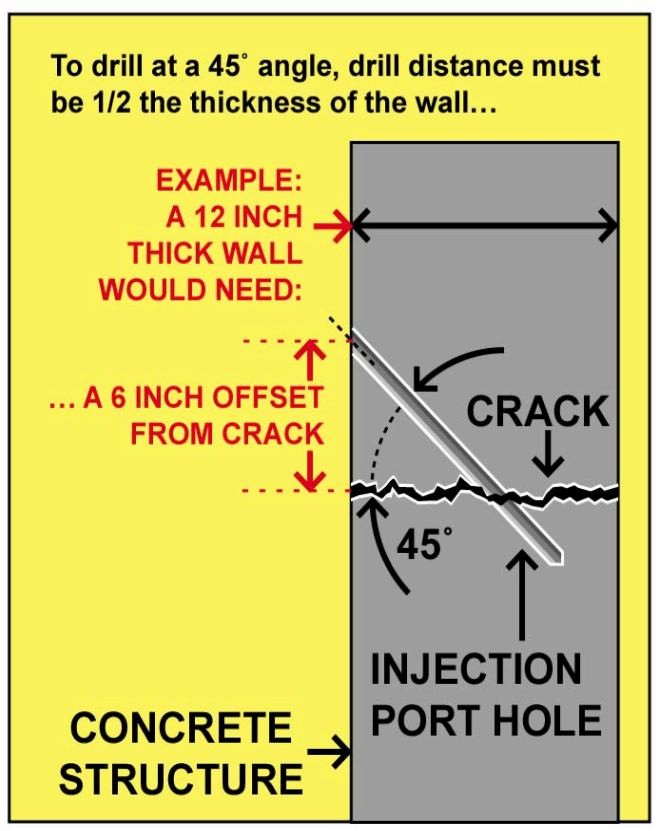
Start at the bottom of the crack and continue working your way up the crack. This will force the material up and through the crack and will push the water up and out.

Horizontal cracks:

Can be started at one end or the other working across the crack.

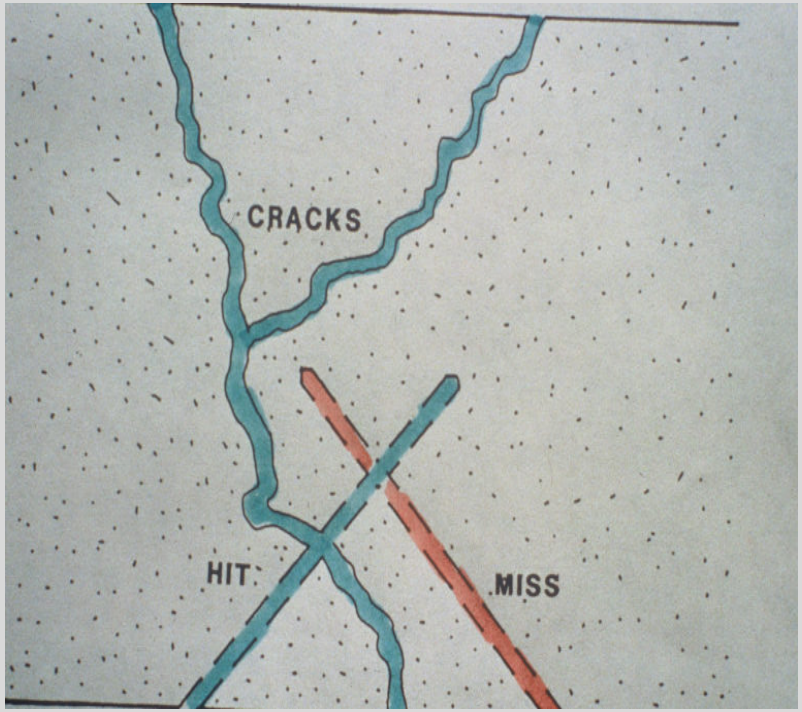
Injection Steps

1. **Spacing:** One of the biggest mistakes made is port space and spacing off the crack.



45 Degree Angle Drilling

Increases the odds of intersecting a crack, which may deflect inside wall.



Packers

Mechanical

Bang In

Application: Crack Injection

Vertical Cracks

Complete Injection

Dardanelle Lock and Dam Tunnels

Injection of the cross passages

Injection

Packing Wide Joints with Oakum

Curtain Wall Grouting

Curtain Wall Grouting can be effective on various structures such as Wood, Steel, Concrete, Rubble Walls, Stone, Block and Brick.

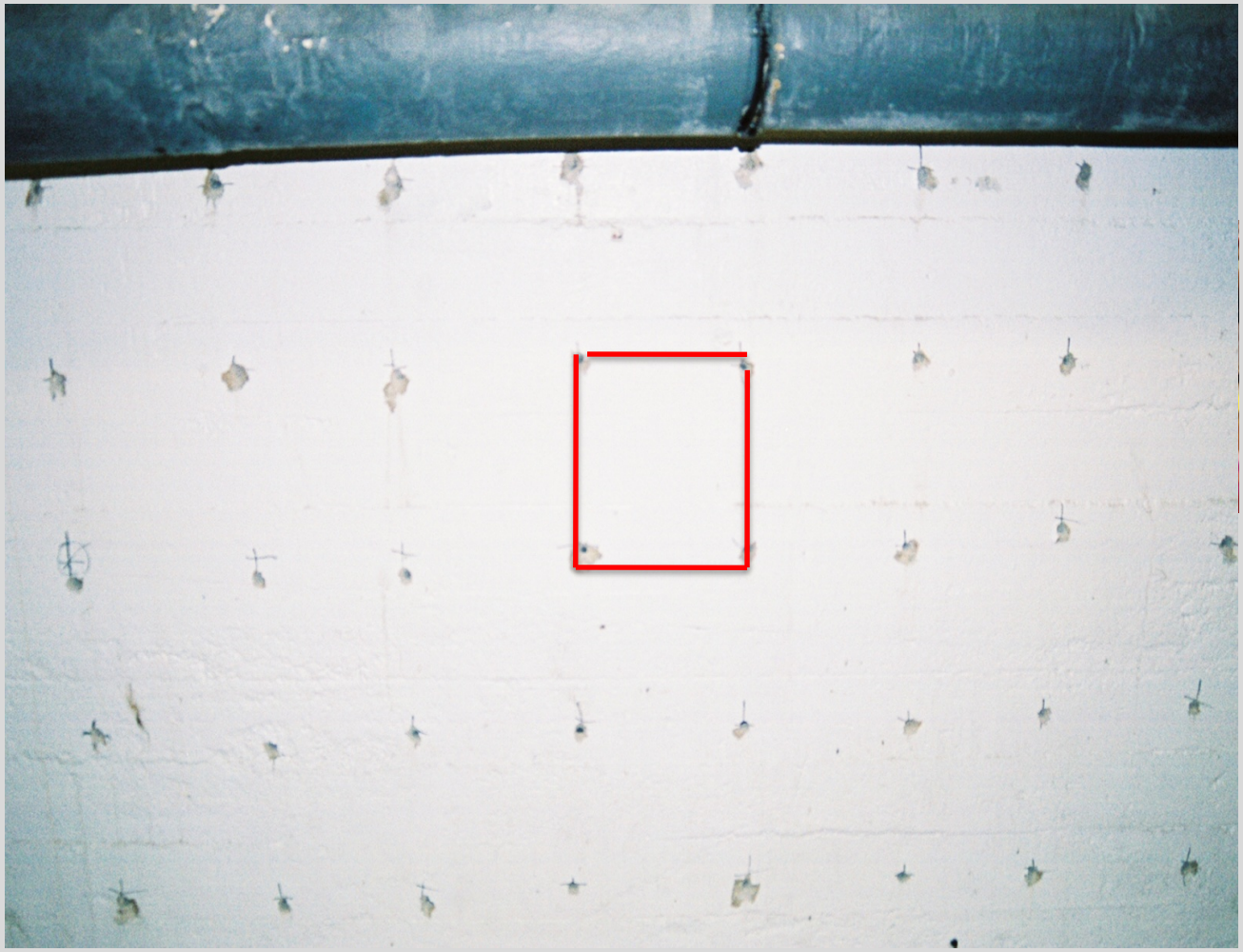
This procedure is used to inject behind a wall or under a slab to create a Positive side waterproofing barrier.

Injection is achieved by drilling through the wall or floor then pumping Chemical Grouts to the back side and into the soil.

Injection holes are drilled on a grid pattern and Chemical Grout is injected under the slab to create a positive side water tight seal.

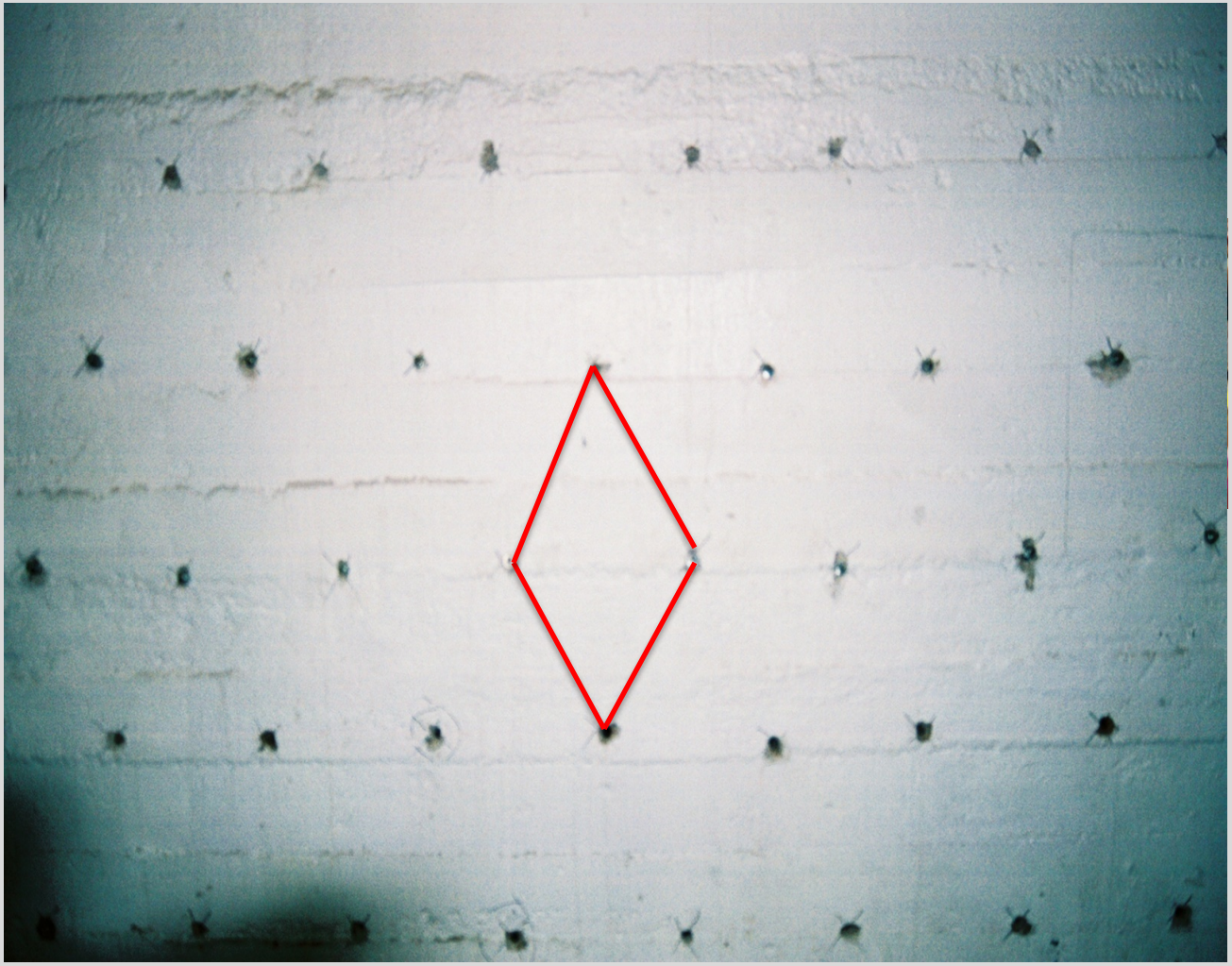
ALCHEMY Spetec

Checkerboard Pattern

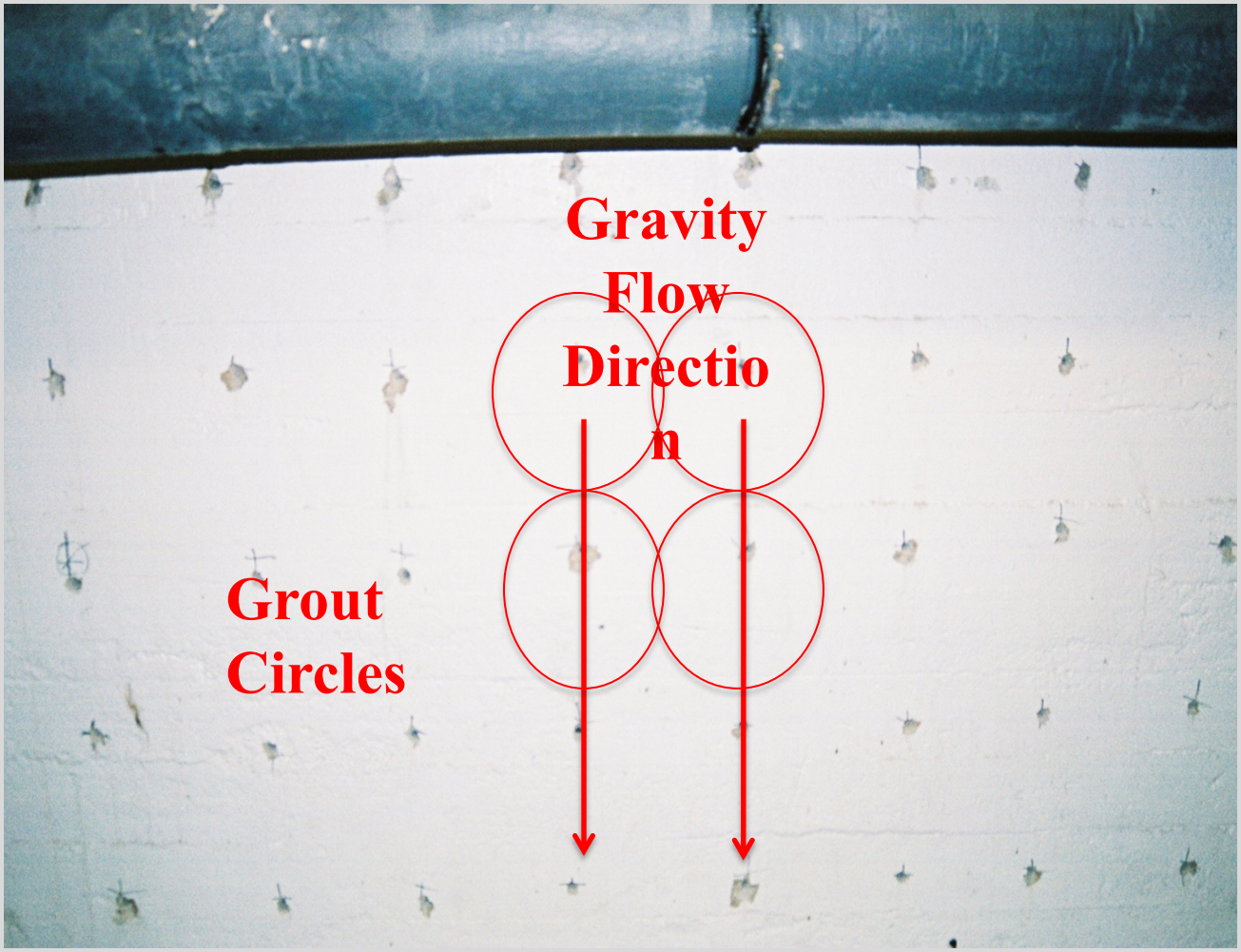


ALCHEMY Spetec

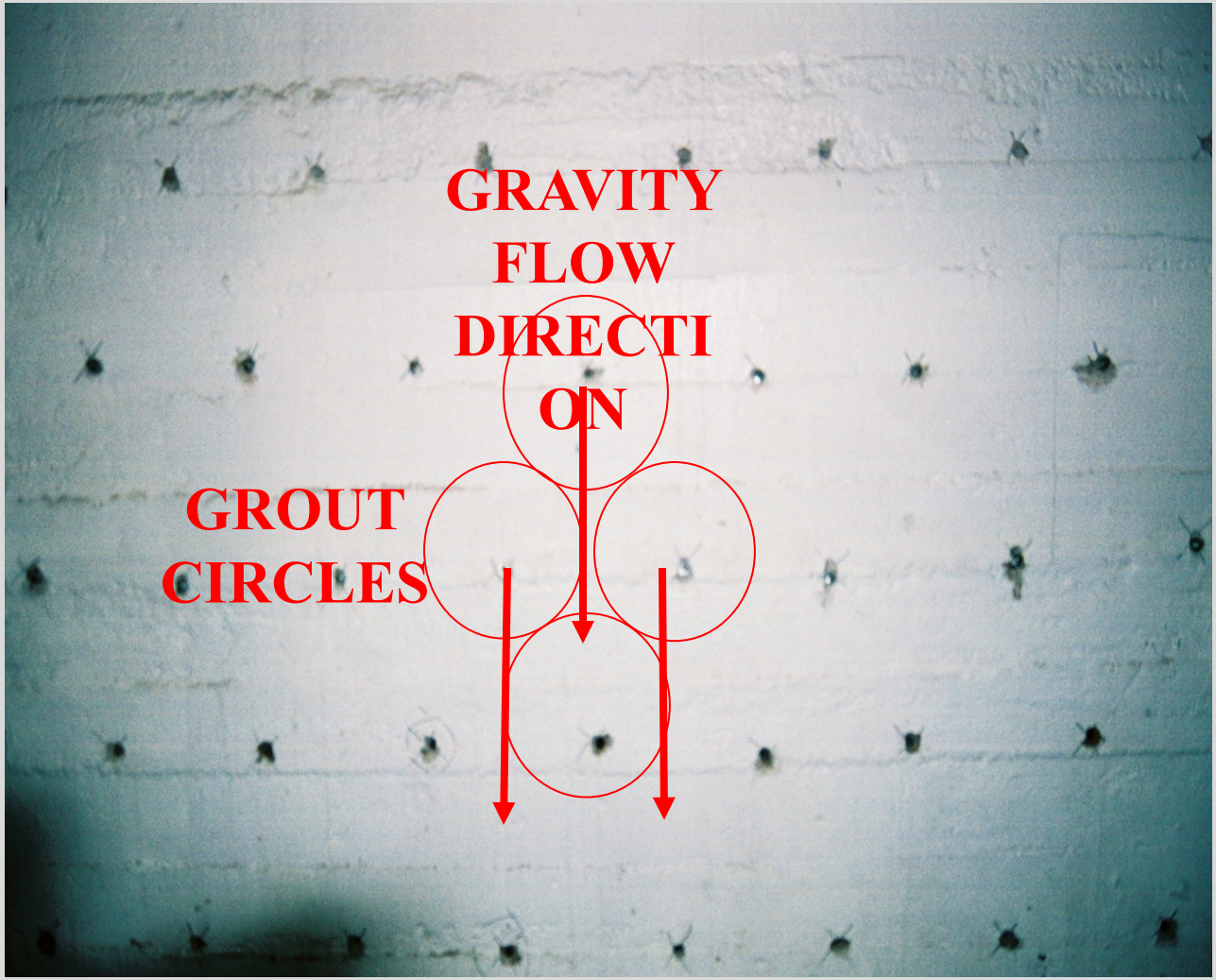
Diamond Pattern



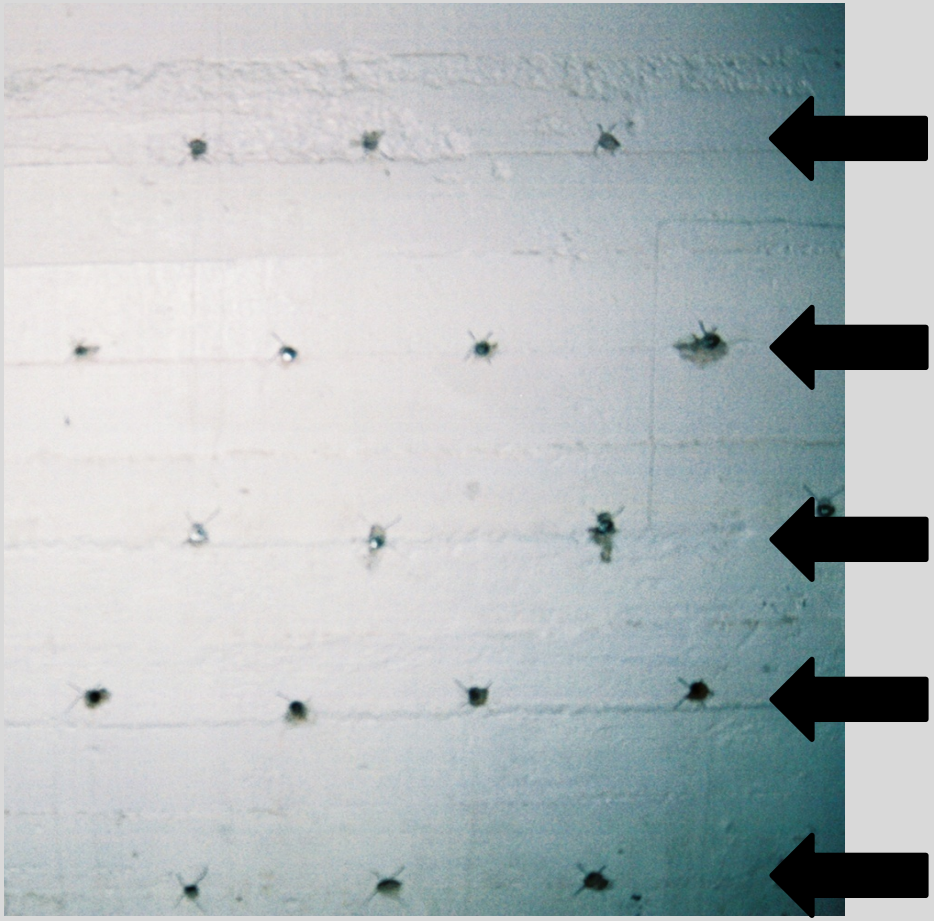
Checkerboard Pattern Gravity Flow



Diamond Pattern Gravity Flow



Injection Sequence



5th injection row

4rd injection row

3rd injection row

2nd injection row

1st injection row

Curtain Wall Injection

When cracks cannot be identified.

Masonry, stone, or CMU walls do not crack inject well.

Previous crack injection has failed.

An agency may have a negative crack injection history.

Brick Structures

Sealed Ring

High Flow Leaks Repaired

ALCHEMY
Spetec

Sealing Pre Cast Manholes

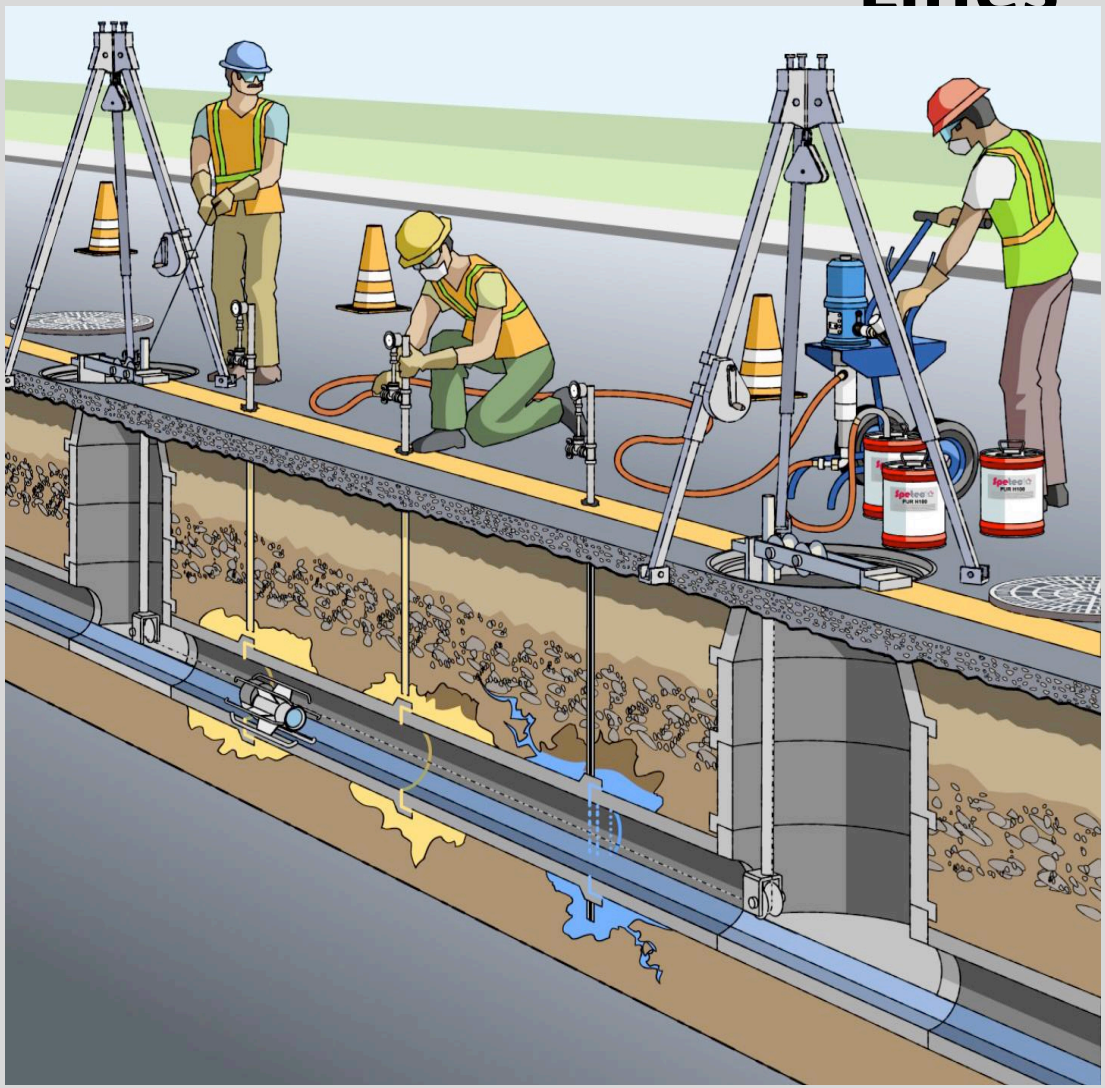
Enjoy Your Work and Take Pride In It

PROBE GROUTING

Water blasting injection probes
into the ground can easily be
achieved by using a Vac truck.

Injection Probes should be inserted
to a depth of 1 foot below the
bottom of the host pipe or foundation.

Probe Grouting Underground Pipe Lines



Sea Wall Stabilization

Grout Applications

- Soil Stabilization
- Water Cut-off
- Waterproofing
- Sewer Grouting
- Crack Injection
- Tunnels

Questions

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Questions

- What does MIC Stand for:
- A: Microbiologically Induced Corrosion
- B: Minor Induce Corrosion
- C: Method for Inducing Corrosion
- D: Methane Gas In Corrosion.

What does Conshield prevent

- A: MIC Corrosion
- B: Prevents Sulphuric Gas from selling
- C: Prevents all corrosion in sanitary sewer systems
- D:Prevents chemical corrosion

How is ConShield used for rehabilitation applications

- A: Clean, Kill Coat
- B: Just spray material onto existing structure
- C: Just spray Conshield mixed with Cementious material onto surface
- D: Do not use Conshield

True or False

- Conshield prevents Hydrogen Sulphide Gas

Lining System should not be used when

- A: The host pipe is collapsed
- B: Flow cannot be diverted from the host pipe
- C: The soil envelope around the host pipe is not stable
- D: All of the above.

True or False

- ConShield prevents corrosion below the flow line.