Alchemco
TODAY'S SOLUTIONS FOR TOMORROW'S PROBLEMS

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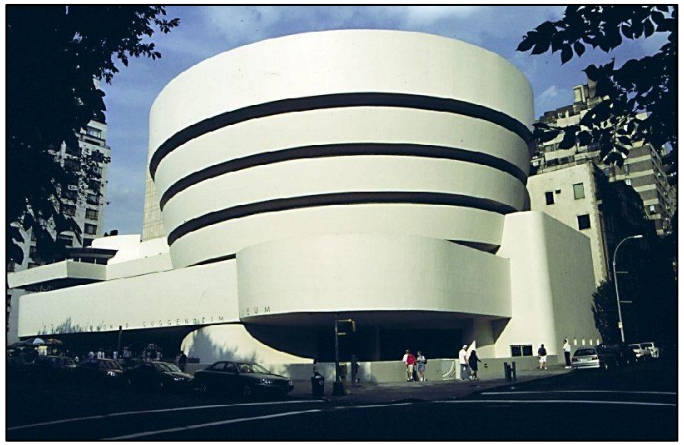

WATERPROOFING CONCRETE STRUCTURES:

NEEDS, BENEFITS & OPTIONS

Course Number: 40410880001

1.0 LU/HSW

Instructor: Paul Shelton

Date: 03/14/2020

CONTINUING EDUCATION AIA

WATERPROOFING CONCRETE STRUCTURES: *NEEDS, BENEFITS & OPTIONS*

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Concrete is one of the most utilized construction materials in the world. However, in order to realize it's maximum potential lifespan, steps must be taken to prevent premature deterioration. Options to effectively waterproof concrete structures include a variety of integral & non-integral products and systems. As with many things, the wide range of products available in the marketplace can sometimes be more confusing than helpful.

This course will provide you with the knowledge necessary to understand what causes concrete to deteriorate … the various methods available to increase it's sustainability & durability … and the advantages & disadvantage of the common waterproofing options being used today.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand why waterproofing is important for the long-term structural integrity of concrete in construction projects

2. Identify the main causes of structural concrete deterioration

3. Discuss the common types of concrete waterproofing applications available in the North American marketplace

4. *NEW Concrete*: Explain why admixtures using 'Crystalline' technology effectively contribute to reducing its maintenance requirements ... and enhance its sustainability

5. *EXISTING Concrete*: Know the difference between using 'Crystalline' technology ... and 'Modified Silicate Gel' technology for topical applications

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WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

Pantheon - Rome

Coliseum - Rome

Aqueduct - Rome

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

- Concrete is the most widely used man-made construction material in the world. In many parts of the world it's easily used twice as much as any other material.

- The use of concrete as a building material can be traced back to Babylonian times, however the modern version of concrete has only been in use since the 1700's, when cement was added to the mixture.

- While the composition of concrete is pretty simple (*cement, aggregates & water*), in many cases the modern day version includes chemical additives that are used to increase the density, longevity & durability of a structure.

- Concrete is a naturally permeable & porous material … full of voids, capillaries, micro-fractures, etc. One of the biggest contributing factors in the deterioration of concrete, is the ingress of water and chemicals into the structure. They use these pathways to penetrate the concrete.

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

- In most cases, the problem of water infiltration into concrete won't fix itself (*unless it does … see the section on integral waterproofing systems*). Over time, there have been numerous ways developed & used to properly & improperly waterproof concrete structures.

- When a concrete structure has a water infiltration problem, the problem needs to be addressed … and it should be done in a comprehensive manner. While it can be a major undertaking to properly identify and correct faulty waterproofing, the results can be far worse if you just adopt a patch-it-and-hope-for-the-best attitude.

- All too often, even well-meaning attempts at treating the symptoms of waterproofing failure serve only to trap or redirect moisture, compounding the problem. Until the waterproofing deficiency is resolved, the problem will only get worse … so it's important to properly identify the correct steps to take as soon as a problem presents itself.

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

The use of concrete in construction projects has many **advantages**, including:

- Low Cost
- Non-Flammable
- Eco-Friendly
- High Stiffness Rating
- High Compressive Strength
- Ease of Fabrication
- Formability

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

However, there are **disadvantages** to using the material as well, including:

- Low Tensile Strength
- Brittleness
- Lack of Long-Term Durability (*in its most basic form*)

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

Premature Deterioration

- Spalling
- Cracking
- Corrosion

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

HOW CONCRETE IS CREATED

- Concrete is created from a mixture of sand, rock, cement and of course water. The aggregate base of the concrete consists of the sand & rock … and the addition of water & cement helps to form a paste that binds everything together. As this paste hardens, the concrete strengthens.

- During the hydration process, Calcium Silicate Hydrate (*CSH*) is formed … as well as Calcium Hydroxide (*CH*), which remains in a dormant state in the concrete.

- Calcium Silicate Hydrate (*CSH*) is a critical component, because it contributes to the setting, hardening, strengthening and volume stability. Calcium Hydroxide (*CH*) provides an alkaline environment, which is important … because it helps protect the steel reinforcement from corrosion.

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

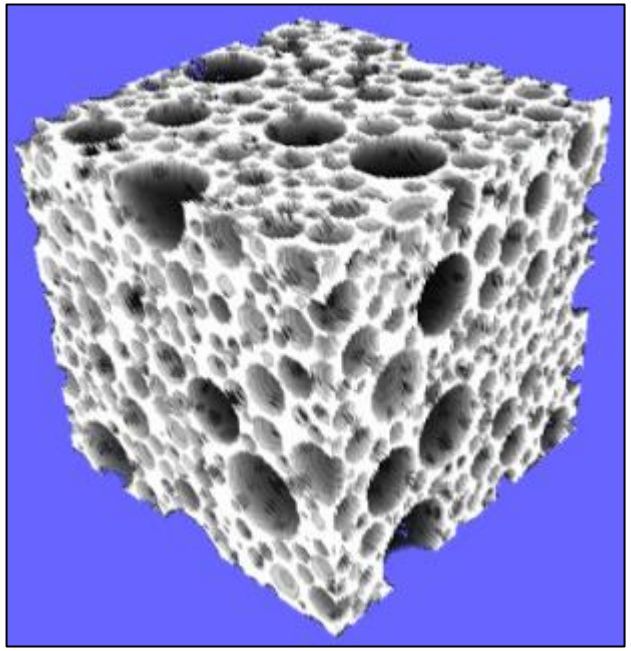
WHY CONCRETE NEEDS TO BE WATERPROOFED

- As previously mentioned, concrete by its nature is '**permeable & porous**' … factors that a well designed and properly installed waterproofing system can help to mitigate.

- **Permeability**: *is the ease with which fluids can move thru a material*. Air pockets and cracks in concrete increase the permeability, and allow increased levels of water & harmful chemicals to migrate in. Steps must be taken to either prevent water from getting to those cracks … or to fill the cracks so the fluids cannot migrate thru them. Older concrete is generally more permeable than newer concrete.

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

- **Porousness**: is similar to permeability, in that it's a measure of how easily fluids pass thru a material. *However, it has more to do with the number and size of the pores in the concrete*. The level of porousness of concrete is determined largely by the amount of water that's used when it is first installed.



WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

- If water and chemicals are allowed to continuously penetrate into concrete over time (*as a result of concrete's natural porousness & permeability*) … it will cause the concrete to prematurely deteriorate. We will explore this further in the next section

- Here is a partial list of problems caused as a result of concrete deterioration:
  - Spalling
  - Stress Cracking
  - Freeze/Thaw Cracking
  - Chloride Penetration
  - Hydrostatic Pressure
  - Corrosion of Steel Reinforcement

WHY IT'S IMPORTANT TO WATERPROOF CONCRETE STRUCTURES

- The problems shown in the past several slides can & will cause concrete to deteriorate. And at their core, **all of those problems are attributable to allowing water to migrate into the concrete**.

- To properly protect the concrete, it is critical to incorporate a waterproofing system that prevents water from entering the concrete and beginning the deterioration process.

WE'LL NOW REVIEW THE MAIN FACTORS THAT CAUSE CONCRETE DETERIORATION …

CAUSES OF CONCRETE DETERIORATION

CAUSES OF CONCRETE DETERIORATION

A number of factors can contribute to the premature deterioration of concrete. These contributing factors include:

- Weather (*Temperature & Moisture*)
- Improper Concrete Mix
- Chemical Interactions (*Corrosion, Carbonation, Chlorides, etc.*)
- Design Flaws
- Poor Construction / Installation Practices

CAUSES OF CONCRETE DETERIORATION

- While concrete can be very durable, **it will deteriorate over time** as a result of weathering. The amount of deterioration depends greatly on exposure to the following factors:
  - *Temperature*
  - *Moisture*
  - *Chemicals*

Chemical Deterioration

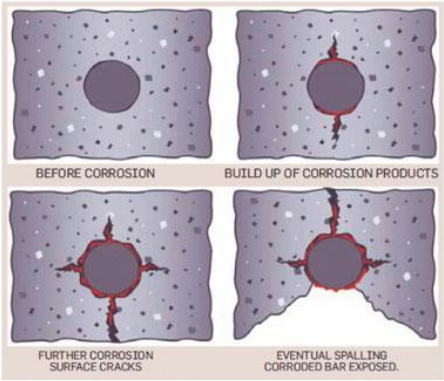
Temperature & Moisture Deterioration

CAUSES OF CONCRETE DETERIORATION

- In addition to being exposed to temperature … moisture … and chemicals; the '**mix**' that's used when the concrete is being made is critical to it's durability. Here are some of the problems that can occur if the mix is incorrect:
  - Too much water (*can cause weakened surface & pitting*)
  - Wrong type of aggregates (*can cause popping*)
  - ASR (*Alkali Silica Reactivity*)
  - ACR (*Alkali Carbonate Reactivity*)
  - Sulfate Attack (*Expansive Reaction*)

CAUSES OF CONCRETE DETERIORATION

- '**CORROSION**' of the steel reinforcing rods is another potential factor in the deterioration of concrete. This is caused when the 'passive layer' of concrete surrounding the steel reinforcement breaks down … exposing the steel. When the steel reinforcement corrodes, it expands in size … exerting a force on the surrounding concrete, which ultimately leads to cracking, spalling, etc. The process accelerates in the presence of chlorides that are dissolved in water from sea water or salts used for de-icing.

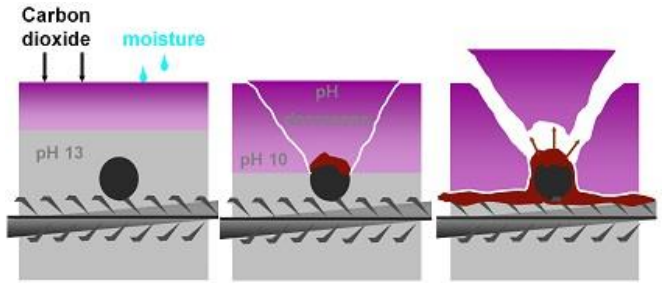


Here is an example of corrosion of the steel reinforcement causing the concrete to 'spall'.

Spalling caused by Corrosion of the Steel Reinforcement

CAUSES OF CONCRETE DETERIORATION

- '**CARBONATION**' is another form of deterioration that occurs when calcium carbonate forms in the cement paste. If water is also present, carbonic acid will be formed **which lowers the pH** of the surrounding concrete. The result will be a weakening & break down the passive layer of concrete surrounding the steel reinforcement. In the presence of oxygen & water, this will then lead to corrosion of the steel.



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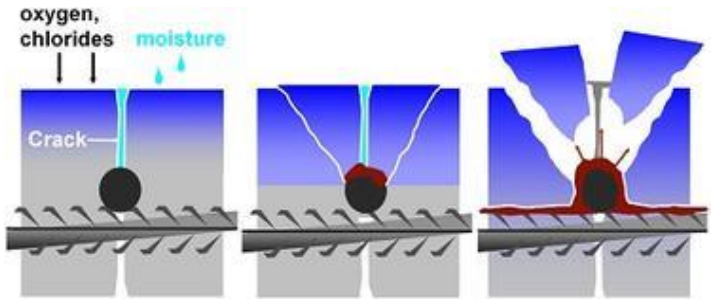
CAUSES OF CONCRETE DETERIORATION

- The presence of '**CHLORIDES**' migrating through the concrete can also cause deterioration of the passive layer surrounding the steel reinforcement. In the presence of water this **will form iron chloride**, which will ultimately cause the corrosion of the steel reinforcement as well.



CAUSES OF CONCRETE DETERIORATION

- **DESIGN FLAWS** can also cause the deterioration of concrete. Some of the common factors attributed to this are:
  - Not properly designing for structural capacity
  - Not adequately accommodating for movement caused by thermal shifts
  - Not planning properly for shrinkage and/or settling

CAUSES OF CONCRETE DETERIORATION

Pitting/Honeycombing

Stress Cracking

Shrinkage Cracking

Even if the project is designed properly, problems can be caused by **POOR CONSTRUCTION and INSTALLATION PRACTICES**:

- Pitting or Honeycombing
- Stress Cracks
- Shrinkage Cracks

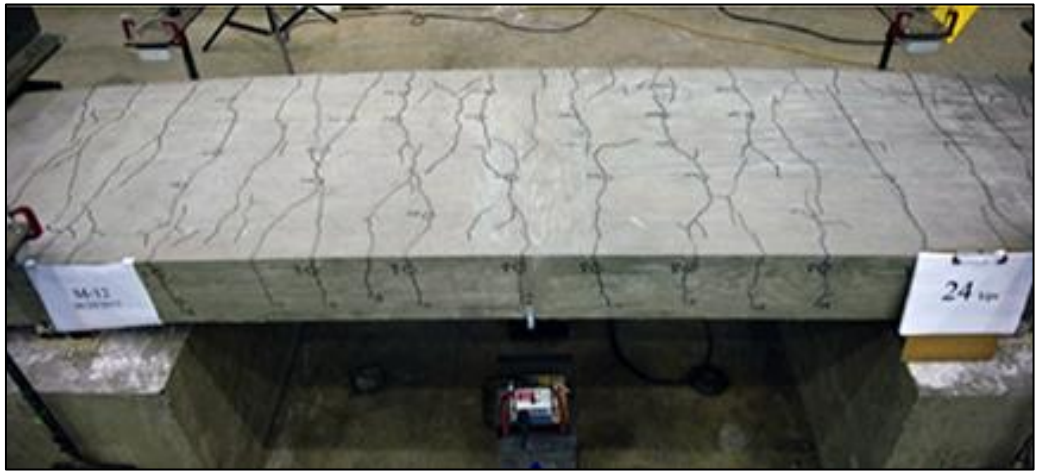
CAUSES OF CONCRETE DETERIORATION

Thermal Stress Cracking

Even if the project is designed properly, problems can be caused by **POOR CONSTRUCTION and INSTALLATION PRACTICES** (*continued*):

- Thermal Stress Cracks
- Tension Cracks

Tension Cracking



CAUSES OF CONCRETE DETERIORATION

- Any of the issues we've just covered will allow chemicals, water & oxygen to migrate into the concrete … which then contributes to the concrete deterioration process.

- As you can see, while concrete is a reliable & commonly used construction material … there are many forces acting on it from the day it's first poured - trying to tear it apart.

- In order to realize the full, long-term functionality of this material, it's critical that the design & installation are handled properly … including the use of the right waterproofing systems for any particular project.

WE'LL NOW REVIEW THE MOST COMMONLY USED METHODS OF WATERPROOFING CONCRETE …

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

(Integral and Non-Integral Systems)

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

- In order to help prevent the premature deterioration of concrete structures, a variety of waterproofing systems have been developed & tried over the years. These systems can either be 'integral' (*inside the concrete*) … or 'non-integral' (*applied to surface of the concrete*)

- While the intent of these various waterproofing systems are the same: to prevent water, chemicals, etc. from penetrating into the concrete (*stopping premature deterioration before it starts*) … the materials & methods that are used vary widely.

- This section will provide a high level summary of the most common concrete waterproofing systems used in North America today …

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

- **SHEET Waterproofing Membranes**
  - Self-Adhesive (*Peel & Stick*) Membranes
  - Thermo-fusible (*Torch-on*) Membranes

- **FLUID APPLIED Waterproofing Membranes**
  - Hot Rubberized Asphalt
  - Cold Fluid Applied Membranes

- **INTEGRAL Waterproofing Systems**
  - Crystalline Technology
  - Modified Silicate Gel Technology

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'SHEET' Waterproofing Membranes:

Self-Adhesive (*peel & stick*)

- Modified Bitumen waterproofing sheets are asphalt-based products that have adhesive 'factory applied' to the backside of the sheet … with a release sheet covering it. The waterproofing sheet is rolled out onto the structure, as the release sheet is removed (*see photo*) … and adhered to the concrete surface.

- Proper surface preparation and conditions are necessary to insure the system is installed properly.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

‘SHEET’ Waterproofing Membranes:

Self-Adhesive (*peel & stick*) … Continued

- Because the sheet is adhered to the surface of the structure, it’s critical the system is installed without any voids … and that no mechanical damage occurs to the sheet. This system also requires professional detailing around all penetrations … angle changes … expansion joints … perimeter edges … etc.

- These systems can be damaged by abrasion or mechanical disturbance caused by traffic in the area, so care must be taken to prevent this from occurring.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'SHEET' Waterproofing Membranes:

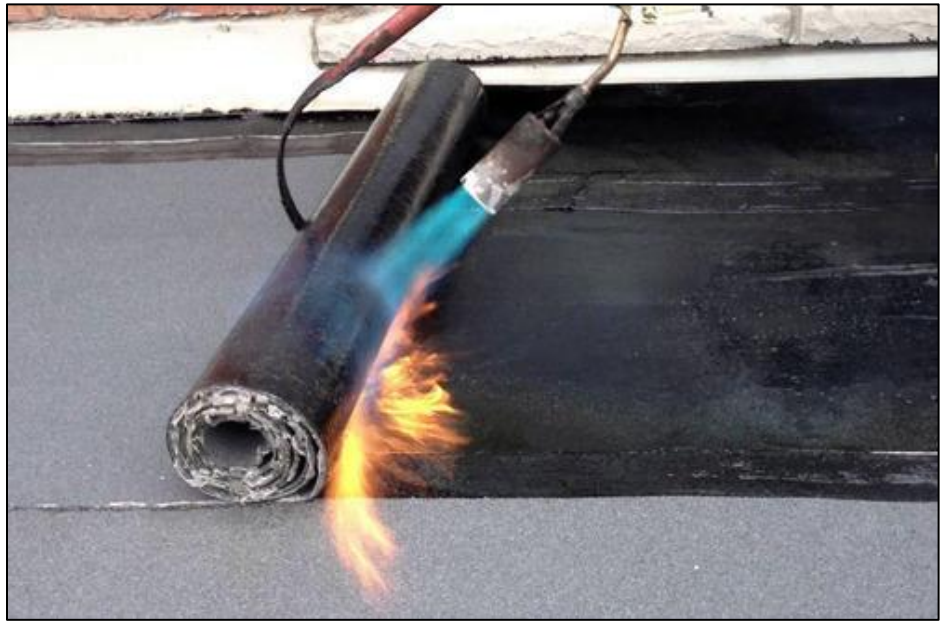
Thermo-fusible (*torch on*)

- Asphalt adhesive on the backside of the modified bitumen waterproofing sheet is melted/liquified with a propane torch. As it cools, it fully adheres the waterproofing material to the concrete.

- The use of open flame can be a problem with this system … with some insurance companies refusing to insure the contractors that use these systems.

- Proper surface preparation is necessary to insure the system is installed properly.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS



‘SHEET’ Waterproofing Membranes:

Thermo-fusible (*torch on*) … continued

- Because the sheet is adhered to the surface of the structure, it’s critical the system is installed without any voids … and that no mechanical damage occurs to the sheet. This system also requires professional detailing around all penetrations … angle changes … expansion joints … perimeter edges … etc.

- These systems can be damaged by abrasion or mechanical disturbance caused by traffic in the area, so care must be taken to prevent this from occurring.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'FLUID APPLIED' Waterproofing Membranes:

Hot Rubberized Asphalt

- The hot rubberized asphalt is heated to the proper temperature range in a kettle, and is generally spread around the structural deck by squeegee. A continuous liquid membrane is created, so there are no seams to be concerned about.

- Proper surface preparation is necessary to insure the system is installed properly.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'FLUID APPLIED' Waterproofing Membranes:

Hot Rubberized Asphalt (*continued*)

- This is a temperature sensitive application, with a narrow range of application temperature for the liquified waterproofing material. Care must be taken to insure the temperature remains consistent from the kettle to the application point.
- It's also critical that the installers apply the proper thickness of material over the entire surface, in order for the system to perform for its intended life.
- These systems can be damaged by abrasion or mechanical disturbance caused by traffic in the area, so care must be taken to prevent this from occurring.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'FLUID APPLIED' Waterproofing Membranes:

Cold Applied

- Proper surface preparation is necessary to insure the system is installed properly.
- These waterproofing systems can be applied by spray rig or squeegee, using cold adhesives to form a continuous liquid membrane. As a result, there are no seams to be concerned with.
- It's critical that the installation crew apply the appropriate thickness of material over the entire surface, in order for the system to meet it's specified useful lifespan.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'FLUID APPLIED' Waterproofing Membranes:

Cold Fluid Applied (*continued*)

- These products are applied to the positive side of the wall in an effort to prevent water, chemicals, etc. from migrating into the porous & permeable concrete structure

- Potential disruption of the waterproofing system can occur if damage occurs. This can be caused by peeling away … mechanical damage … etc.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'INTEGRAL' Waterproofing Membranes:

Crystalline Technology 'Admixture'

- These products are mixed into the concrete either at the plant or on-site at the time of batching. The active ingredients in the admixture react with the calcium hydroxide and other by-products that were formed during the concrete hydration process to form impermeable crystalline structures that effectively plug & block the micro-cracks, pores, and capillaries that naturally occur as concrete is formed. The chemicals in the admixture also help form a protective layer around the steel reinforcement … encapsulating it and preventing corrosion from occurring.

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- Once the concrete hardens, the remaining active ingredients in these admixtures remain dormant inside the concrete … and will reactivate to block future micro-cracks and voids, if water & air find their way into the concrete again.

- These products cause no visible change to the appearance of the concrete surface.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'INTEGRAL' Waterproofing Membranes:

Crystalline Technology 'Dry Shake'

- These products are shaken on top of the concrete. The active ingredients penetrate into the concrete, using water as a transport mechanism. They then react with the calcium hydroxide and other by-products that were formed during the concrete hydration process to form impermeable crystalline structures that effectively plug & block the micro-cracks, pores, and capillaries that naturally occur as the concrete is formed.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'INTEGRAL' Waterproofing Systems:

Crystalline Technology 'Slurry'

- Used exclusively on projects that have existing concrete structures
- Heavy liquid slurry, that is applied to the surface of the concrete structure by brush, broom or sprayed with the proper spray rig. Proper surface preparation is necessary to insure the system is installed properly
- Active ingredients in these products use the process of diffusion to absorb into the concrete, reacting with the calcium hydroxide and other by-products that were formed during the concrete hydration process that occurred when the concrete was first formed.

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'INTEGRAL' Waterproofing Systems:

Crystalline Technology 'Slurry' (*continued*)

- This chemical reaction create an impermeable network of crystalline structures that the block & plug the existing micro-cracks and voids. This prevents moisture, chemicals, etc. from deteriorating the concrete itself, or corroding the steel reinforcement.
- The active ingredients in these products remain dormant inside the concrete, and can reactivate to block future micro-cracks, etc. in the presence of air and water
- These products remain on the surface <u>changing the visible surface of the concrete</u>

COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'INTEGRAL' Waterproofing Systems:

Modified Silicate Gel (*flexible*)

- These products are sprayable liquids that penetrate into concrete using water as a transport mechanism. The products are sprayed on the surface of the structure, and travel deep into the concrete by process of diffusion. Proper surface preparation is necessary to insure the system is installed properly.

- When installed, these products form an impermeable & flexible waterproof structure inside the concrete. This gel interacts with calcium hydroxide and other by-products leftover from the hydration process that occurred when the concrete was initially poured to block capillaries, cracks, micro-fractures, etc.

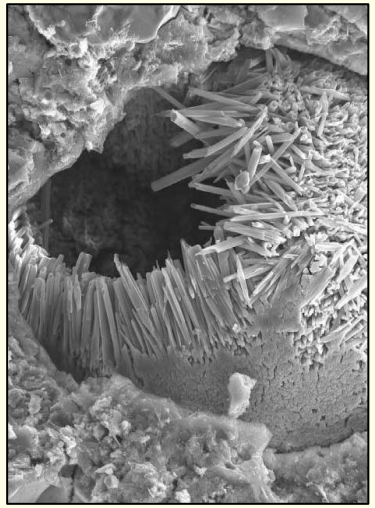
COMMONLY USED TYPES OF WATERPROOFING APPLICATIONS

'INTEGRAL' Waterproofing Systems:

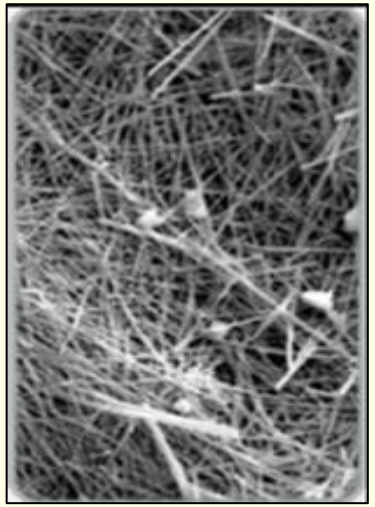
Modified Silicate Gel (*flexible*) … continued

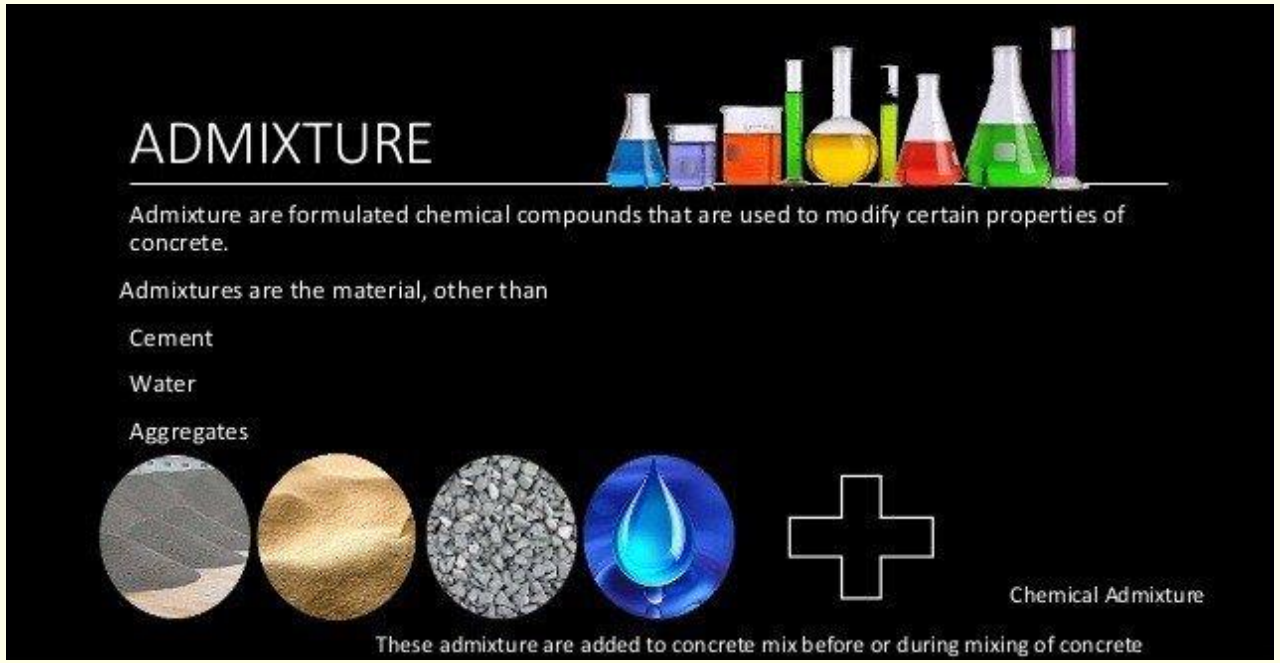
- Clear & colorless … these products <u>DO NOT change the exterior appearance of the concrete surface</u>
- In addition to filling & blocking the microcracks and voids inherent in the existing concrete, it also has the ability to 'self-heal', as future micro-cracks occur in the concrete structure. In effect, it's a permanent waterproofing solution.
- The result is an integral waterproofing system, that cannot be damaged … and that effectively blocks water penetration for the life of the structure.

WE'LL NOW TAKE A LOOK AT HOW TO MAKE 'NEWLY POURED' CONCRETE MORE SUSTAINABLE …



REDUCED MAINTENANCE & INCREASED SUSTAINABILITY FOR *NEW CONSTRUCTION* CONCRETE PROJECTS





REDUCED MAINTENANCE & INCREASED SUSTAINABILITY FOR *NEW* CONCRETE PROJECTS

- Crystalline waterproofing materials can be used in a wide variety of construction applications. These products are generally made up of silica, cement and proprietary chemicals, which when exposed to water have the ability to plug pores, capillaries, micro-cracks & other small voids that form in the concrete. These systems fall into the 'integral' waterproofing system category.

- There are three main ways to apply crystalline technology products to provide the waterproofing properties that concrete needs to help avoid deterioration.

  - Surface-apply multiple slurry coats, using an air compressed sprayer or by hand using a stiff broom or masonry brush (*this method is used for existing structures*)

  - Broadcasting the product onto the surface of freshly installed concrete (*dry shake*)

  - Incorporate waterproofing products into the concrete as its being mixed, by using admixture version

IN THIS SECTION, WE'LL FOCUS ON THEIR USE IN 'ADMIXTURES' …

REDUCED MAINTENANCE & INCREASED SUSTAINABILITY FOR *NEW* CONCRETE PROJECTS

- While there are many different types of concrete admixtures available (*to speed up hardening, etc.*) … this specific type of concrete admixture (*crystalline based technology*) offers a permanent & integral waterproofing solution.

- When added to concrete during the mixing process, moisture and free lime within the mix, combine with active chemicals in the admixtures … creating a continuous barrier of insoluble crystals which penetrate deep into the capillary structure of the concrete.

- These capillaries and interstices are blocked to the passage of water, but continue to allow the passage of air & water vapor, enabling the concrete structure to breathe.

REDUCED MAINTENANCE & INCREASED SUSTAINABILITY FOR *NEW* CONCRETE PROJECTS

- Rather than adding a waterproofing system to the concrete structure after it's already been constructed, an admixture can be added to the concrete before it is poured. The most effective of the waterproofing admixtures utilize 'crystalline' technology.

- Crystalline admixtures turn the normally permeable & porous concrete into an impermeable barrier, that helps protect the steel reinforcement within the structure from corrosion

- Unlike waterproofing systems that are added after the concrete is already in place … using admixtures to waterproof the concrete adds almost no labor cost at all. The chemicals can be mixed into the concrete at the plant … or on-site, just prior to pouring.

- This is the least expensive way to integrally waterproof a concrete structure. It drastically reduces (*or eliminates*) the need for ongoing maintenance over the life of the structure.

REDUCED MAINTENANCE & INCREASED SUSTAINABILITY FOR *NEW* CONCRETE PROJECTS

- Using the admixture method of waterproofing, means the system is not reliant on skilled workmanship to work effectively

- It creates a system that is very durable … and cannot be damaged like waterproofing systems that are attached to the surface of the concrete. It will not tear, delaminate, decompose or wear out.

- VOC free … completely recyclable after demolition of a structure.

REDUCED MAINTENANCE & INCREASED SUSTAINABILITY FOR *NEW* CONCRETE PROJECTS

- Crystalline admixture products typically come in dry powder form
- These products are hydrophilic instead of hydrophobic … which allows them to use any future water that penetrates into the concrete (*thru new micro-cracks*}. to react with chemicals sitting dormant in the structure, to create new crystals that will in effect 'self-heal' the concrete
- These products can be used on concrete structures that are designed for the containment of potable water

REDUCED MAINTENANCE & INCREASED SUSTAINABILITY FOR *NEW* CONCRETE PROJECTS

Here is a partial list of waterproofing applications suitable for using Crystalline technology on:

- Waterproofing of foundations, slabs and walls
- Water Storage Tanks in Municipal & Industrial Wastewater Applications
- Potable Water Tanks & Facilities
- Elevator Shafts and Parking Garages
- Basements
- Secondary Containment Centers
- Swimming Pools

WE'LL NOW LOOK AT 'INTEGRAL' WATERPROOFING FOR 'EXISTING CONCRETE' STRUCTURES …

Modified Silica Gel – Spray Application

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

Crystalline Slurry – Brush Applied

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

Examples of MODIFIED SILICATE GEL installations

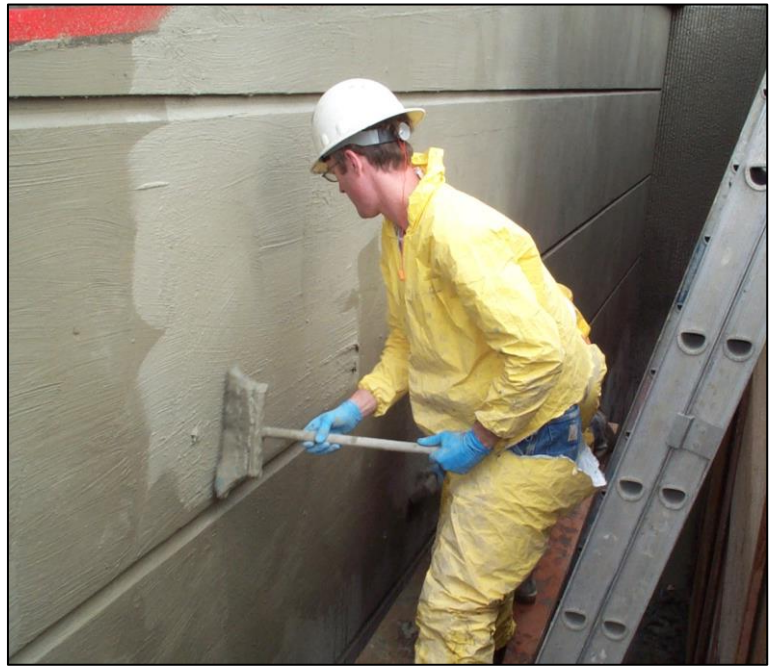
Modified Silica Gel – Spray Application

Modified Silica Gel – Spray Applications

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS (*cont*)

Examples of CRYSTALLINE SLURRY installations

Crystalline Slurry - Spray Applied



Crystalline Slurry – Brush Applied

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

Both of these technologies fall into the '*integral*' waterproofing systems category. Here are some advantages of using **INTEGRAL Waterproofing Systems** instead of 'external' membrane systems:

- Absence of Seams
- Low Overall Cost
- Negative or Positive Side Application
- Protects reinforcing steel from Corrosion
- Environmentally Friendly … allows concrete to be recycled following demolition
- Not compromised by:
  - Poor Site Conditions
  - Poor Membrane Workmanship
  - Worksite Damage

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

Modified Silicate Gel

Crystalline

- Both product types have proven technology, having been used on projects around the globe for over 30 years
- 'Foe becomes Friend' – the active ingredients in both of these waterproofing technologies use available water as a transportation mechanism to migrate thru the cracks & pores in the existing concrete.
- They both leave latent chemicals behind (*embedded in the concrete*) that will chemically react with any new intrusion of water. This allows the concrete to self-heal when new micro-cracks, etc. form over time.

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

- These products differ from simple concrete densifiers in that, after initially waterproofing the concrete … they remain dormant inside the concrete until water penetrates into the concrete, reactivating them. At that point, the same chemical reaction occurs again … blocking the passage of water. This will continue over the life of the concrete, making the waterproofing of the structure 'permanent'.

- Both product types are capable of resisting high hydrostatic pressures, and can be used where there is extreme exposure … such as tunnels, dams, pools, subways, etc.

- Both of these product types require proper surface preparation before applying the products

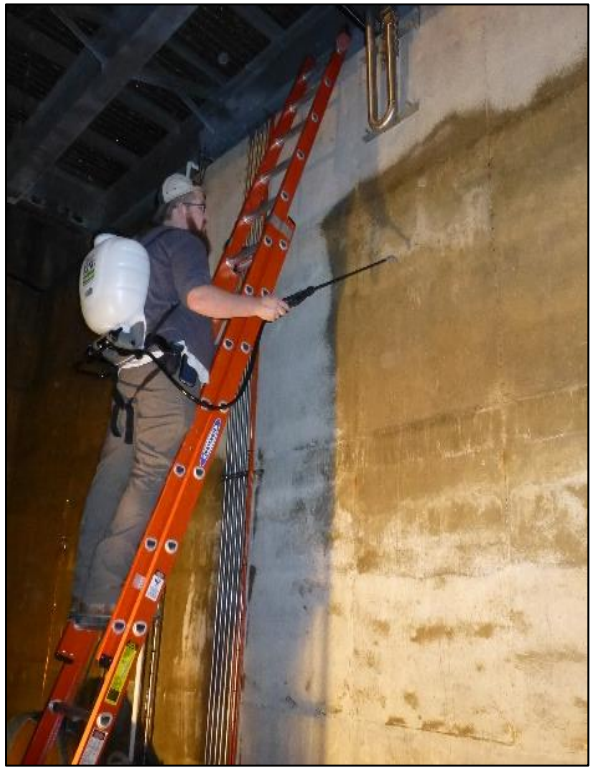
MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

ADVANTAGES OF MODIFIED SILICATE GELS

- FAST Installation … in fairly open applications, contractors can cover 8,000+ square feet per hour (*or 60,000+ square feet per day*). This is several times as much area as a similar crew can apply using Crystalline based products.

- The gel products are applied using a simple spray system, and completely absorb into the concrete … leaving the surface of the concrete unchanged. This can be a critical factor in projects where maintaining 'the look' of a structure is important (*historical structures … restorations … highly visible structures … etc.*)

- The surface of the concrete can still be painted or coated … however, any material that impedes the penetration of water into the concrete will also prevent the latent chemicals from reacting and blocking any new micro-cracks that form over time. These gel products also do not affect the 'slip resistance' of the concrete surface

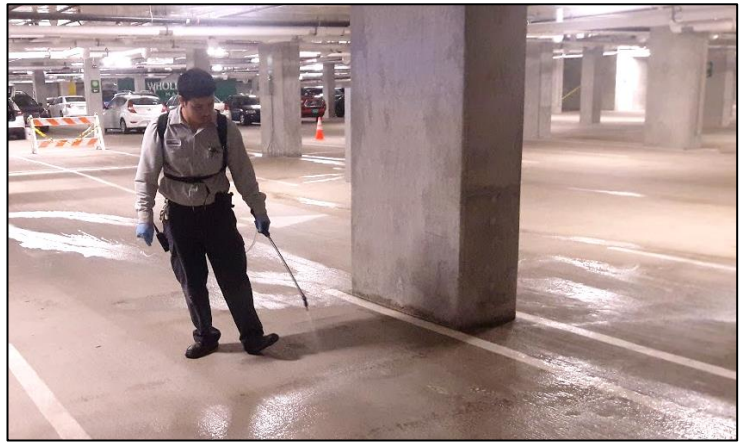


Modified Silica Gel – Spray Application

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

ADVANTAGES OF MODIFIED SILICATE GELS (*continued*)

- In addition to fast application rates, these products are easy to apply … requiring only basic spray equipment
- Can bridge initial/existing cracks that are 5 times wider than those that Crystalline technology products can (*2.0 mm vs. 0.4 mm*)
- Increases the hardness of the concrete from 6 to 8 on the Mohs scale
- Crystalline products should not be used in structures that will experience constant movement or are subject to high thermal stress … however, Modified Silicate Gel based products can perform more effectively in these cases, due to their inherent flexible characteristics



Modified Silica Gel – Spray Applications

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

SUMMARY OF PRO'S & CON'S FOR MODIFIED SILICATE GELS

PROS

- FAST to install … requires very simple spray equipment
- Resists extreme hydrostatic pressure
- Becomes an integral part of the substrate
- Reactive … can seal existing cracks up to 2.0 mm wide, and future hairline cracks up to 0.4 mm
- Allows concrete to outgas moisture (*breathable*)
- Highly resistant to aggressive chemicals
- Non-toxic and VOC free … completely recyclable after demolition of a structure
- Cannot puncture, tear or come apart at the seams
- No loss of slip resistance on concrete surface
- No costly surface priming or leveling prior to application.
- Does not require sealing, lapping and finishing of seams at corners, edges, etc.
- Can be applied to the positive or the negative side of the concrete surface
- Increases the hardness of the concrete from 6 to 8 on the Mohs scale (*the same hardness as Granite*)
- Less costly to apply than most other methods
- Not subject to deterioration … permanent solution
- Increases bond strength between cementitious materials

CONS

- Concrete surface must be dry before beginning application of waterproofing products

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

Crystalline Slurry - Spray Applied

ADVANTAGES OF CRYSTALLINE (*surface applied*)

- Applied as a cementitious slurry coat to above-grade or below-grade concrete, either as a single coat or as the first of a two-coat application
- Prevents the penetration of water and other liquids from any direction by causing a catalytic reaction that produces a non-soluble crystalline formation within the pores and capillary tracts of concrete and cement-based materials

MODIFIED SILICATE GEL vs. CRYSTALLINE TECHNOLOGY ON *EXISTING* CONCRETE PROJECTS

SUMMARY OF PROS & CONS FOR CRYSTALLINE PRODUCTS (*continued*)

PROS

- Resists extreme hydrostatic pressure
- Becomes an integral part of the substrate … not subject to deterioration
- Can seal hairline cracks up to 0.4 mm
- Allows concrete to breathe
- Highly resistant to aggressive chemicals
- Non-toxic
- Does not require a dry surface to install
- Cannot puncture, tear or come apart at the seams
- No costly surface priming or leveling prior to application.
- Does not require sealing, lapping and finishing of seams at corners, edges or between membranes
- Can be applied to the positive or the negative side of the concrete surface

CONS

- Slurry coat is applied to face of the concrete … changing the appearance of the structure
- Brush application is SLOW and labor intensive.
- Spray application of these products requires specialized spray equipment
- Should not be used on projects where the structures may experience substantial building movement
- Projects may require two coats to provide enough product to waterproof the structure. In these cases, there can be a danger of material peeling off.

CASE STUDIES

Integral Waterproofing Systems

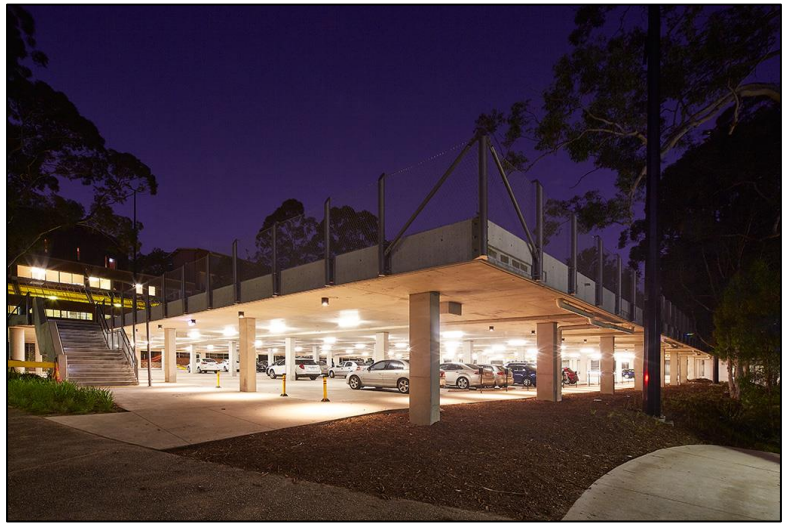
Admixtures & Topical Applications

CASE STUDIES

Crystalline Admixture

Construction of Concrete Slab

Completed Field



View from below

Abbotsleigh School – Sydney, Australia

Hockey Field over a Car Park

In **2014**, a Crystalline Admixture was used to waterproof a **15,000+ square foot** post-tensioned concrete slab that formed the base for a raised hockey field that was being built over a parking structure.

The consultant & builder had successfully done a similar slab at MLC School in Sydney, Australia **back in 1995** … and were confident in using the same product, since that MLC School project **is still leak-free today.**

CASE STUDIES

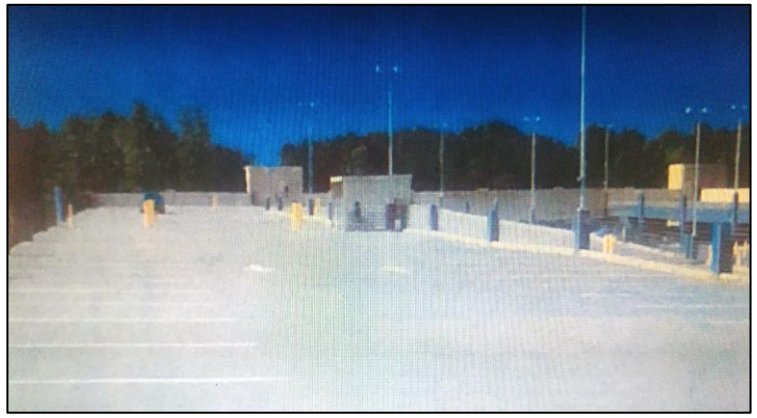
Crystalline Admixture

INPASA Water Cooling Tower Tanks - Liberacion, Paraguay

A Crystalline Admixture product was used to waterproof and protect these Concrete Water Tanks when the facility was constructed in **2017**

CASE STUDIES

Topical Application



Lowes Corporate Headquarters - Mooresville, NC

Approximately **95,000 square feet** of parking deck was waterproofed in **2006** using a spray applied Modified Silicate Gel.

CASE STUDIES

Topical Application

Miami International Airport - Miami, FL

A spray-on Modified Silicate Gel was applied to **700,000 square feet** on the Dolphin and Flamingo parking ramps between **2010 - 2015**.

The parking ramp was already more than 25 years old when the waterproofing project was undertaken.

This type of integral waterproofing systems was selected because the project issues to be overcome included:

- High humidity
- Salt environment
- Many areas are susceptible to ponding and contaminants … including jet fuel residue

CASE STUDIES

Topical Application

Petersen Event Center – Pittsburgh, PA

In October of **2007**, a Modified Silicate Gel product was applied to protect the exterior of this building on the University of Pittsburgh campus

Approximately **48,000 square feet** of the surrounding concourse, deck and steps were treated with the spray applied waterproofing.

CASE STUDIES

Topical Application

Prince Resort – North Myrtle Beach, SC

In **2006**, a Silicate Gel waterproofing material was spray applied to over **144,000 sq.ft.** of this beachfront parking structure. Because the gel waterproofs the concrete 'below the surface' … there is no deterioration of the product from surface traffic.

CASE STUDIES

Topical Application

Stamford Grand Resort Hotel – Sydney, Australia

Pond over a Car Park

Following completion of this project in **1988,** the pond was filled with water plants and many different species of fish, proving the ***non-toxicity*** of Modified Silicate Gel products.

This entire pond is built on top of a parking ramp, so it is possible to walk underneath and inspect the underside of the concrete. **Thirty years later** the product is still performing flawlessly.

This is a great example of Modified Silicate Gel's ability to withstand ***hydrostatic pressure*** … and provide concrete structures with long-term waterproofing … while at the same time being ***environmentally friendly***

Pond sits directly over Underground Parking Structure

CASE STUDIES

Topical Application

2017 Water Test being conducted
(6 locations – 3 over cracks & 3 over solid surface)

Top Level of Parking Ramp - Australia

In **1988**, a Modified Silicate Gel product was spray applied to the **21,500+ square foot** top level of this parking ramp in Australia.

The watertight status of the parking deck was confirmed by Roger Scerri from the Building Research Centre, University of New South Wales in August **1993** … and a 100% watertight seal was once again confirmed by Mahaffey Associates in April **2017**.

There has now been over **30 years of watertight performance without any interim maintenance** being performed on this project.

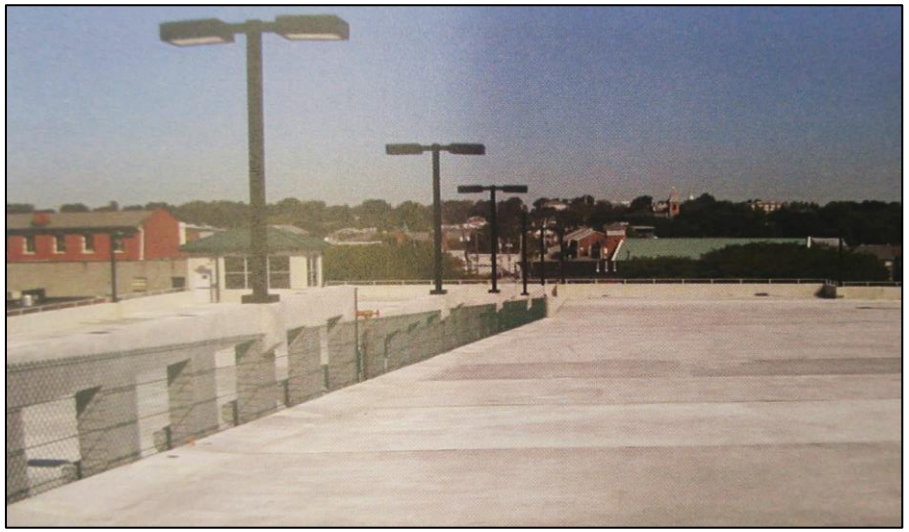
CASE STUDIES

Topical Application

Northside Hospital-Forsyth near Atlanta, GA

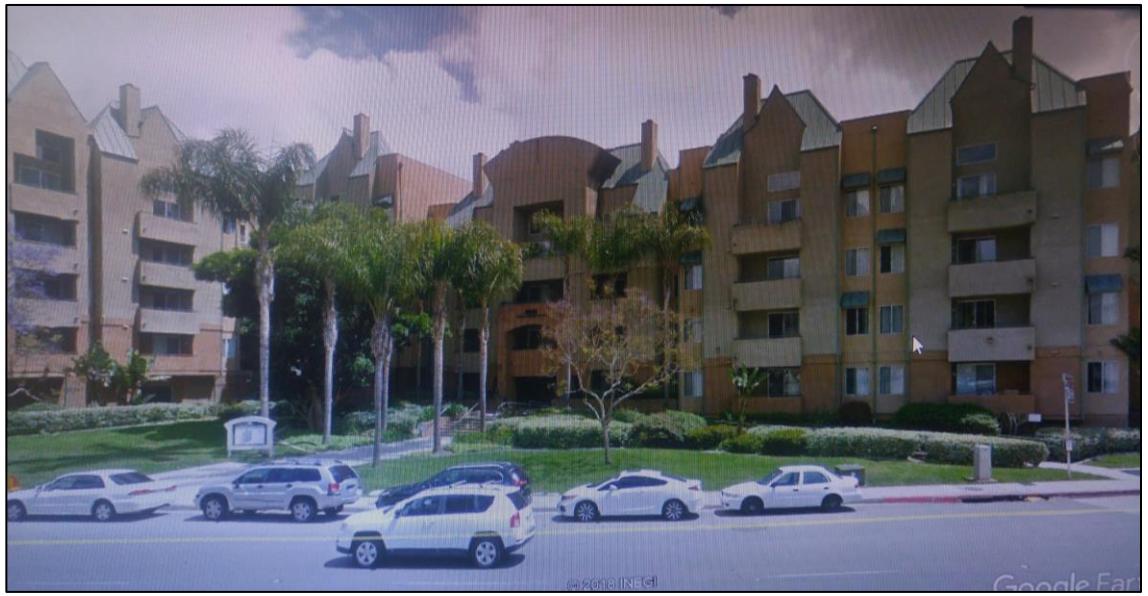
50,000+ sq.ft. of parking ramp was waterproofed in **1999**. The engineer on the project (*Sedki & Russ*) opted to use a Modified Silicate Gel product instead of their normal sprayed polyurethane 'trafficable membrane' because they believe 'membrane' and 'traffic' are not compatible.

"Those systems are complex, time consuming, expensive and not particularly reliable". Whereas the Modified Silicate Gel product was fast, reliable and cost efficient.



CASE STUDIES

Topical Application



Garden Communities Condo & Hotel Complex – San Diego, CA

300,000 square feet of podium decks (*with post-tension cables*). Parking decks, and walkways were waterproofed using a spray applied Modified Silicate Gel, during the three construction phases of this project: **1999 – 2001.**

The post-tensioned podium decks were allowed to cure … and were then waterproofed & pond tested. The decrease in cost, combined with the increase in 'speed of application', made this a very attractive option for the contractor.

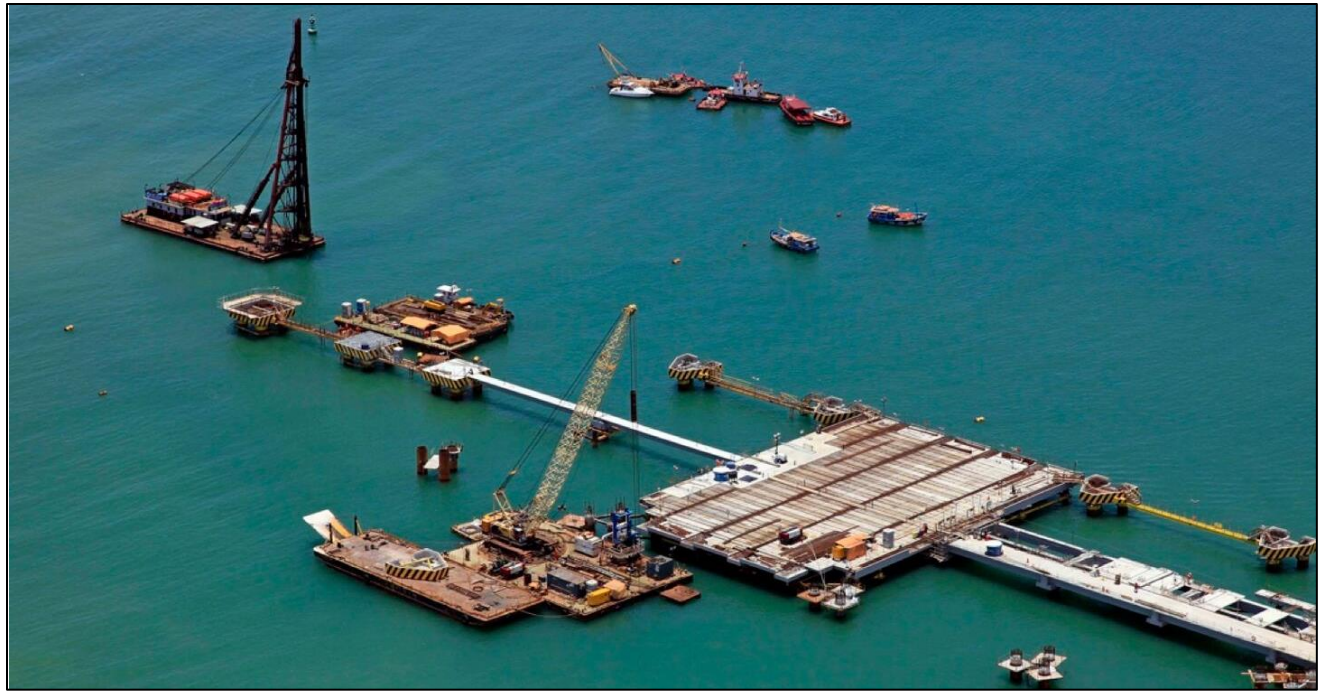
CASE STUDIES

Topical Application

Petrobras Terminal - Brazil

This **2010** project consisted of waterproofing **33,000 square feet** with a Modified Silicate Gel.

This type of system was selected by one of the largest oil companies in the world, because of it's excellent concrete **protection against chloride ions** … and for being a 100% watertight solution.



CASE STUDIES

Topical Application

Pittsburgh International Airport –
Pittsburgh, PA

In 1986, a Modified Silicate Gel waterproofing was applied to protect **1 million square feet** of runway at this important U.S. airport.

Runways 10L - 28R

CASE STUDIES

Topical Application

Wahooo! Water Park –
Bahrain City Center, Bahrain

In 2009, a Modified Silicate Gel product was applied 200,000 square feet of water holding areas, at this newly constructed indoor/outdoor water park.

CASE STUDIES

Topical Application

Hatfields & McCoys Dinner Theater - Pigeon Forge, TN

This 6,000 square foot Water Containment Tank/Pool, that's an integral part of the stage, was waterproofed with a Modified Silicate Gel in **2017** … to correct a chronic leak the owner had been unable to stop for 2 years.

The project was completed in less than 2 days, allowing the Dinner Theater to resume operations quickly.

CASE STUDIES

Topical Applications

Alberto Braglia Stadium – Modena, Italy

This refurbished stadium located in Modena, Italy was originally built in 1936 and is currently home to Modena F.C.

In **2010**, a Modified Silicate Gel product was spray-applied on **160,000+ square feet** of pre-cast stands, after an acetic acid wash was used to remove a residual release agent. This opened up concrete pores to ensure required penetration.

The stands were then fitted with seating, following the application of a colored slip-resistant resin surfacing. The Modified Silicate Gel prevents absorption below the concrete surface without any loss of surface adhesion.

CASE STUDIES

Topical Application

Piedmont Hospital – Atlanta, GA

A spray applied Modified Silicate Gel was used to waterproof **163,500 square feet** of the main parking ramp for this facility.

This project consisted of waterproofing the entire parking ramp roof … as well as a 10’ wide perimeter around each of the remaining seven parking levels. It was completed in two phases between **August 2000** - **March 2001**.

CASE STUDIES

Topical Application

Nhat Tan Bridge – Hanoi, Vietnam

A Modified Silicate Gel product was installed on this **1 million+ square foot** concrete bridge deck (*8 lanes wide*) as it was constructed in **2013-14**.

The bridge provides a high-speed connection between Hanoi City and the Noi Bai International Airport.

SUMMARY

There are a number of different products & installation methods available to properly waterproof all types of concrete structures … and no one product or method is right for every project. It is important however, for the long-term sustainability of concrete structures, that they do receive the type of waterproofing system that meets their needs. This includes new construction projects, as well as existing structures.

As we've demonstrated during this presentation … concrete by its very nature is subject to premature deterioration & decay if not properly protected. The weather & elements are unrelenting in their assault on concrete structures around the world. We hope the time spent covering this information has helped clarify this picture for you … and we stand ready to help guide you towards the right solution for any projects you may be working on.

This concludes The American Institute of Architects Continuing Education Systems Course

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ALCHEMCO offers a complete line of Concrete Waterproofing Products … in addition to Masonry Waterproofing Products … and Graffiti Removal Products

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SPRAY-ON WATERPROOFING PRODUCTS

- CretePro Premium Masonry Waterproofing Sealer
- CretePro Ultra Waterproofing Agent
- TechCrete 2500 Waterproofing Agent
- TechCrete Bridge & Deck Waterproofing Agent
- TechCrete Masonry Waterproofing Agent

GRAFFITI REMOVAL PRODUCTS

- GraffitiBlok Concrete Cleaner
- GraffitiBlok Concrete Etch
- GraffitiBlok Emulsifying Cleaner
- GraffitiBlok Paint & Stain Remover
- GraffitiBlok Graffiti Remover
- GraffitiBlok Graffiti Blocker & Concrete Waterproofing
- GraffitiBlok Graffiti Blocker & Masonry Waterproofing

ACCESSORY WATERPROOFING PRODUCTS

- CretePro Ultra Crack & Void Activator
- CretePro Ultra Waterproofing Activator
- TechCrete Accelerating Agent
- TechCrete Crack & Void Treatment
- TechCrete Concrete Cleaner
- TechCrete Concrete Etch
- TechCrete Emulsifying Cleaner
- TechCrete Expansion Joint
- TechCrete HP Concrete Repair
- TechCrete Paint & Stain Remover
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