Using Water Repellents to Prevent Water Intrusion into Above-Grade Masonry

AIA Continuing Education Provider

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To **print or exit** the course at any time, press the **ESC** key on your keyboard. This will minimize the full-screen presentation and display the menu bar.

This course includes **videos**. To view the videos, follow the instructions on the individual slides.

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Purpose and Learning Objectives

Purpose:

Water intrusion creates a variety of problems for masonry structures, including freeze-thaw damage, chemical- and pollution-based attacks, efflorescence, calcium carbonate stains, and mold. This course reviews the application and specification considerations related to water repellents and how they can help to prevent these problems.

Learning Objectives:

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

- list the problems water creates for masonry structures that affect the durability and aesthetics of the building and the health of the occupants
- state the role water repellents play in preventing those problems and the factors to consider when applying water repellents
- compare the three most common types of clear, penetrating, silicone-based water repellents in terms of composition, mechanisms of action, and performance
- discuss the goals of the Environmental Protection Agency (EPA) to improve air quality and reduce the harmful effects of volatile organic compounds (VOCs) and how VOCs relate to water repellents, and
- summarize the various performance test methods and specification preparation considerations to ensure proper product selection and project implementation.

Contents

Water-Related Problems

Water-Related Problems

Problems that water intrusion creates for masonry structures include the following:

- Freeze-thaw damage
- Chemical- and pollution-based attacks
- Efflorescence
- Calcium carbonate stains
- Mold

Calcium carbonate encrustations

Why Water Repellents Are Needed

Unprotected masonry commonly absorbs water.

A 2 ft X 2 ft section of this wall is treated with a water repellent. The area is easily identified when water is applied; it repels the water and remains dry. Notice how the untreated area darkens as the water is absorbed.

The following series of slides depict some of the more common water-related problems.

Why Water Repellents Are Needed

- **Freeze-thaw damage**
- **Chemical- and pollution-based attacks**
- **Efflorescence**
- **Calcium carbonate stains**
- **Mold**

Water has long been recognized as the most destructive natural element to masonry structures. We will discuss how desirable characteristics of masonry, such as cost effectiveness, low maintenance, and durability, can be compromised when the masonry is left unprotected.

Listed above are some of the more obvious water-related problems. Less obvious consequences of water penetration are the erosion of structural metals, such as reinforcing steel, supports, and anchors.

Freeze-Thaw Damage

Damage to masonry structures can be caused by the freeze-thaw process.

Freeze-thaw damage begins when the water freezes and expands. The volume of frozen water is 9% greater than liquid water, so when water freezes, pressure is exerted on the masonry. When the pressure surpasses the tensile strength of the masonry, cracks will result. During this process, the voids are enlarged, allowing the accumulation of additional water during the next thaw. This leads to additional cracking during the next freeze.

Substantial damage can occur over subsequent freeze-thaw cycles.

An example of freeze-thaw damage to unprotected concrete

Freeze-Thaw Damage

In addition to being an aesthetic issue, the integrity of the structure is also affected. If this is left unchecked, the problem will only get worse.

Along with cracking, the pressure can also cause flaking and chipping, known as spalling. Masonry spalling results in the flaking of the outer layer of brick, exposing the inner layers, which are typically softer, more porous, and more susceptible to further freeze-thaw damage.

In severe cases of spalling, a masonry structure will crumble and fall apart.

Spalling can be seen on first and second rows of this soft Chicago brick

Chemical- and Pollution-Based Attacks

Carbonic acid forms when carbon dioxide mixes with water. If the acidic water penetrates into masonry, it will deteriorate and corrode the masonry and reinforcing steel. This process is known as carbonation.

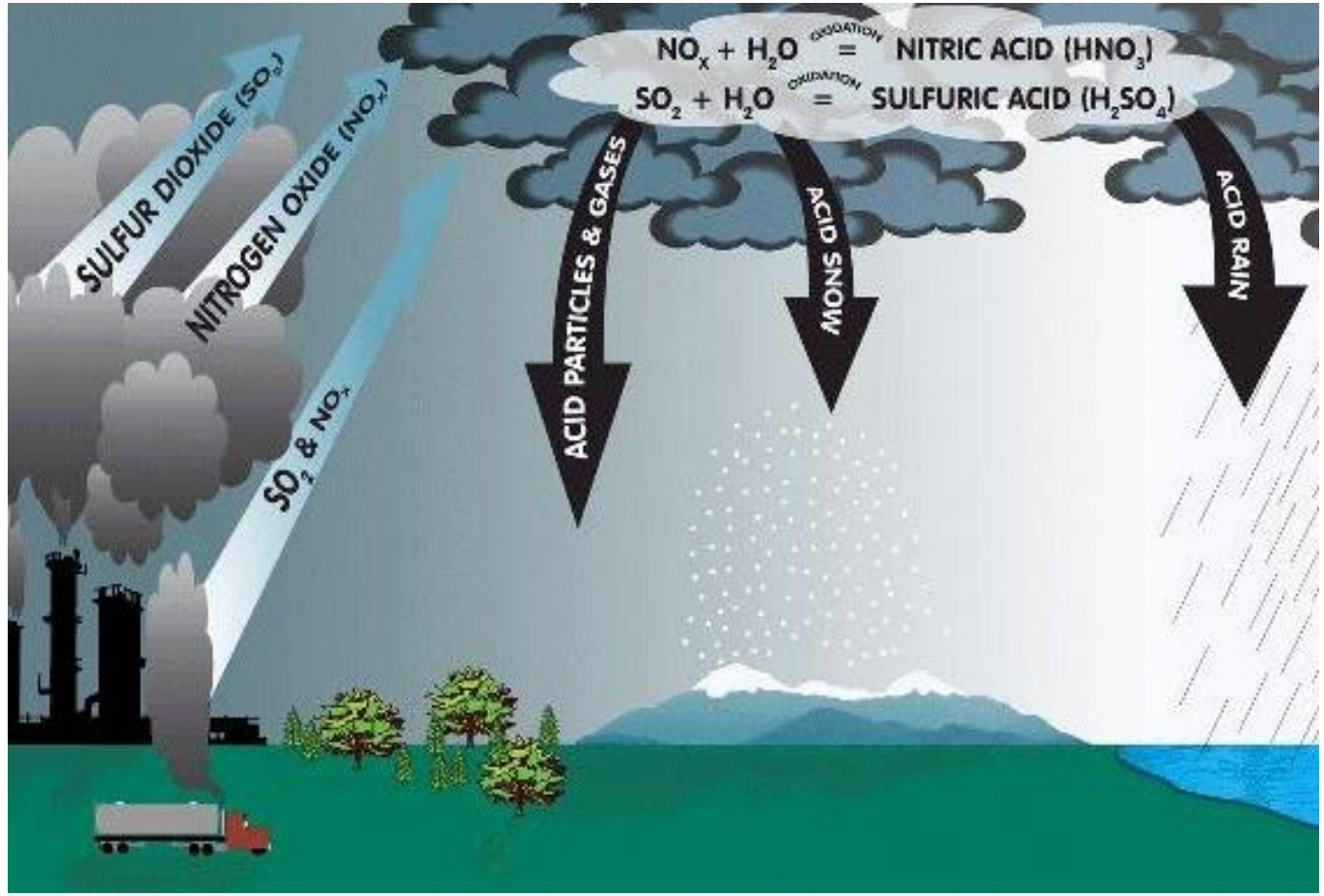
Chloride ions or salts that are carried into structures in rainwater are also extremely corrosive to reinforcing steel. When this happens, the reinforcing steel expands and causes the masonry to crack and spall.

Airborne pollutants cause deterioration of masonry

Chemical- and Pollution-Based Attacks

Another source of corrosion is created when sulfates, nitrates, and water combine in the atmosphere to form acids that fall as rain, otherwise known as acid rain.

When acid rain falls on concrete and masonry, it attacks their calcium compounds, causing deterioration.



The formation of acid rain

Efflorescence

Efflorescence has been an obstinate problem that has caused trouble for masonry since it first appeared thousands of years ago on ancient masonry walls.

Efflorescence appears as a white, powdery residue on the surface of concrete or masonry. It is caused by water that migrates to the surface carrying soluble salts. When the water evaporates, the salts are left behind. These efflorescent salt deposits tend to appear usually about a month after building construction, and sometimes as long as a year after completion.

An example of the white, powdery residue known as efflorescence

Efflorescence

There are three conditions that must exist for efflorescence to occur:

- There must be water-soluble salts present in the masonry.
- There must be sufficient moisture in the wall to render the salts into a soluble solution.
- There must be a path for the soluble salts to travel to the surface where the moisture can evaporate, thus depositing the salts, which then crystallize and cause efflorescence.

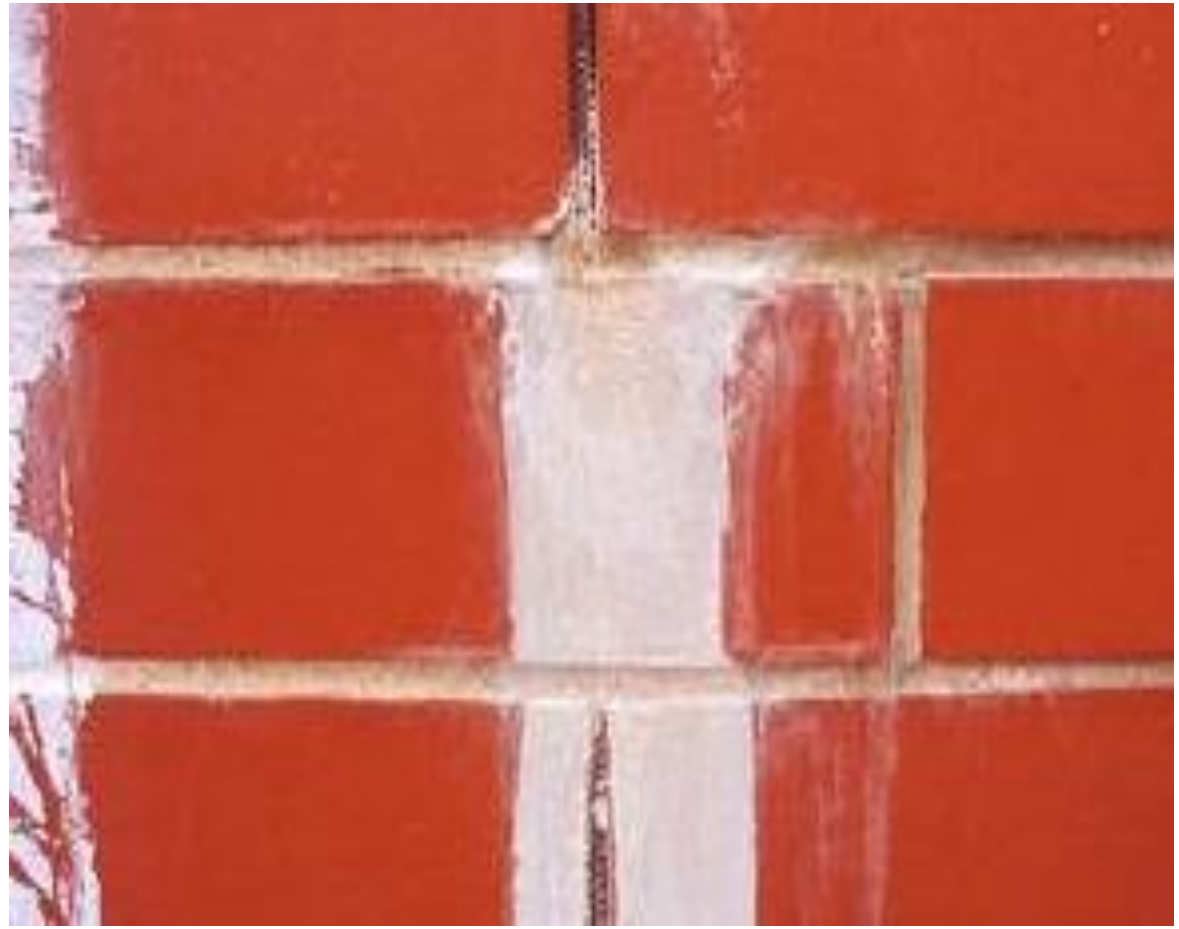
In more severe cases, it is commonly referred to as *building bloom*, as large areas of the structure are affected.

Calcium Carbonate Stains

Similar to efflorescence, calcium carbonate stains occur when water migrates to the surface carrying soluble calcium hydroxide that is deposited as the water evaporates.

These stains are commonly referred to as lime run and appear as hard, encrusted streaks.

It is much easier for water to transport the dissolved calcium hydroxide through structural openings. This is the reason that staining is most likely to appear around joints, cracks, and weep holes.



An example of lime run

Mold

When mold spores drop on areas where there is excessive moisture—such as where leakage may have occurred in roofs, pipes, walls, or where there has been flooding—they will grow.

Mold grows well on paper products, cardboard, ceiling tiles, and wood products. It can also flourish in dust, paints, wallpaper, insulation, drywall, carpet, fabric, and upholstery. Mold spores constantly circulate in both indoor and outdoor air and will prosper on any surface that provides moisture and a source of food. Appearing as a wooly growth in damp, stagnant areas, mold will actually break down masonry surfaces if left untouched.

The most common indoor molds are cladosporium, penicillium, and aspergillus.

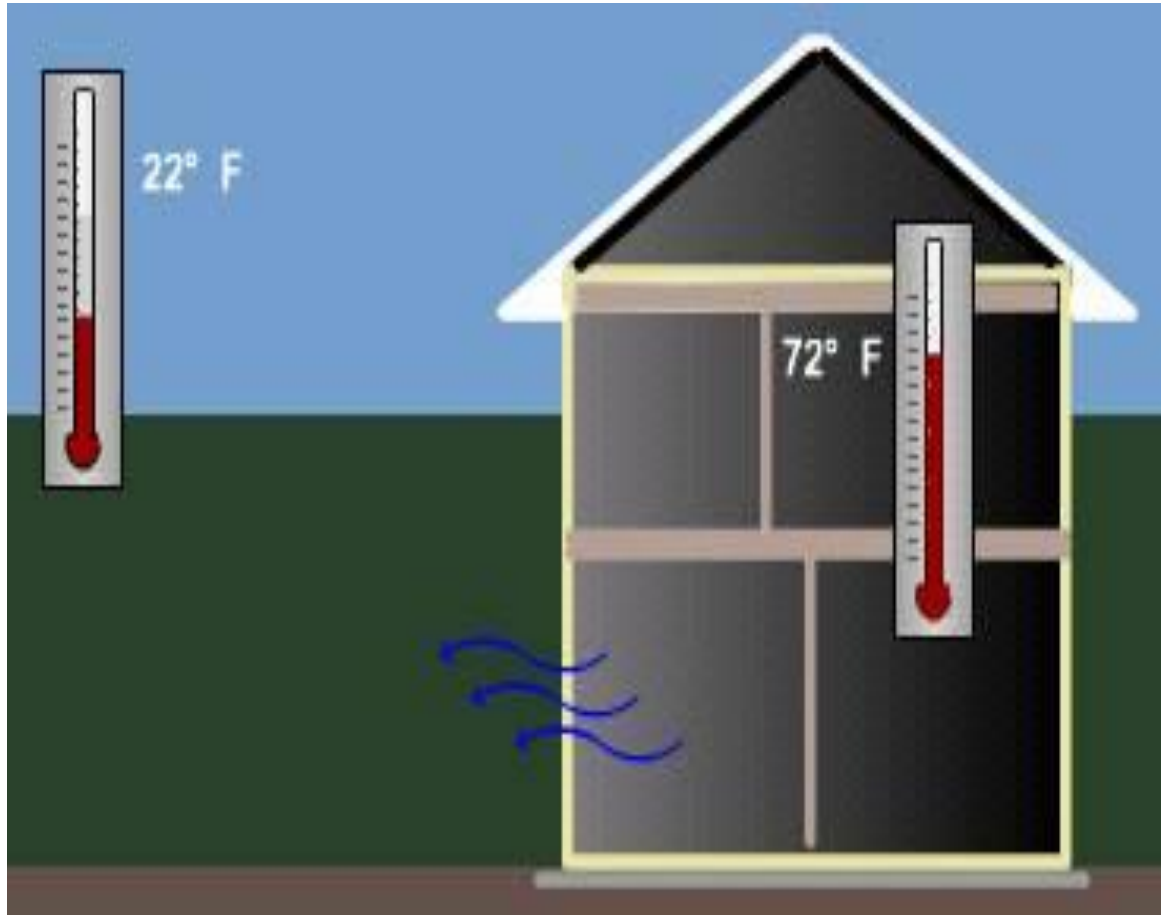
An example of the wooly growth known as mold

Mold

Exposure to mold can cause a variety of health issues ranging from mild symptoms, such as stuffy nose, wheezing, or itchy eyes and skin, to more severe effects, especially for those with allergies to molds or with asthma. Severe reactions include fever and shortness of breath.

Additionally, studies from the World Health Organization (WHO) suggest a possible link between early mold exposure and development of asthma in some children, especially among those who may be genetically susceptible to asthma development, and that measures that improve housing conditions can decrease morbidity from asthma and respiratory allergies.

Since mold is dependent upon moisture, the best way to control its growth is to control the moisture.



Water Repellents and Breathability

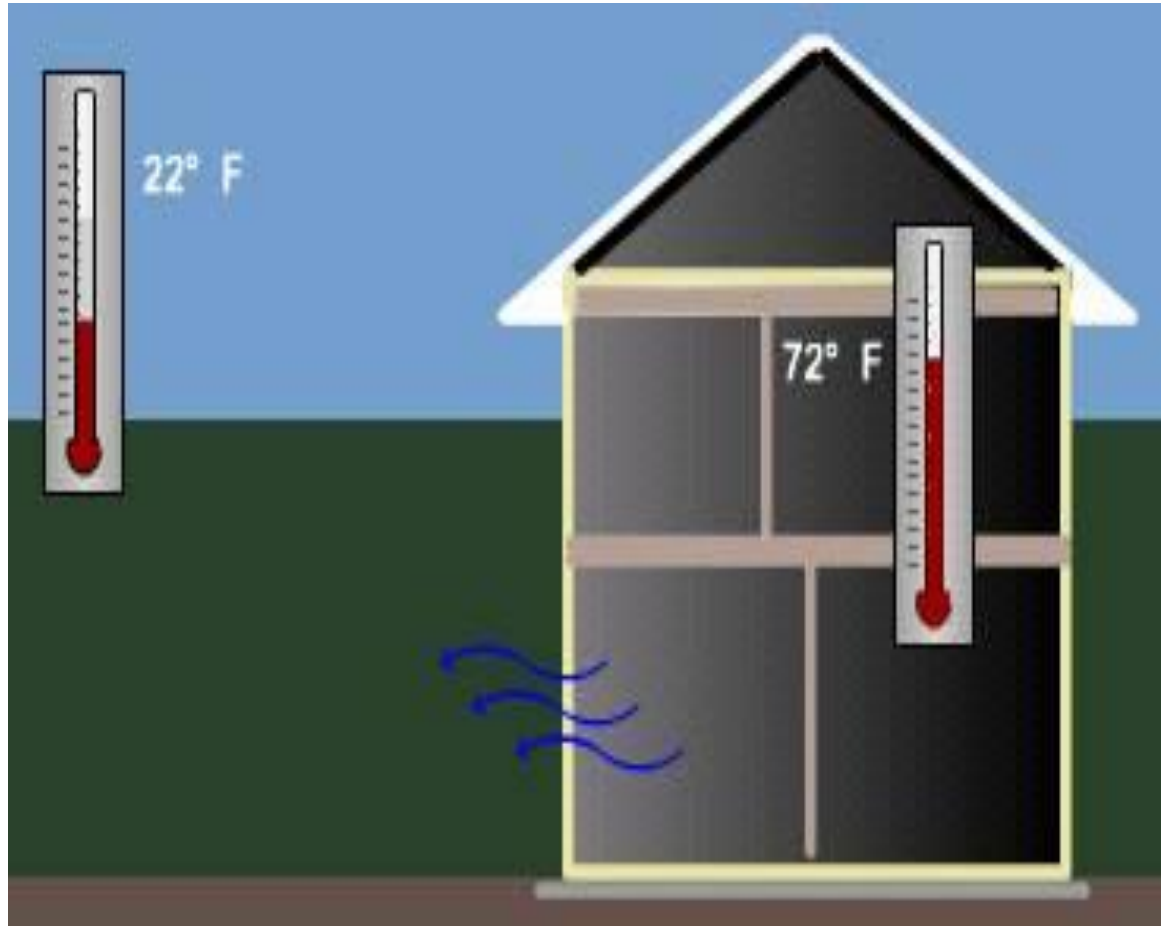
Moisture Vapor Transmission

In order to understand breathability, moisture vapor transmission must be understood.

Due to differences in pressure, warm, moist air typically travels to areas where the air is cool and dry.

When this movement of air is from the outside to the inside of a structure, it is called positive vapor transmission.

And when air moves from the inside to the outside, it is called negative vapor transmission.



Negative vapor transmission

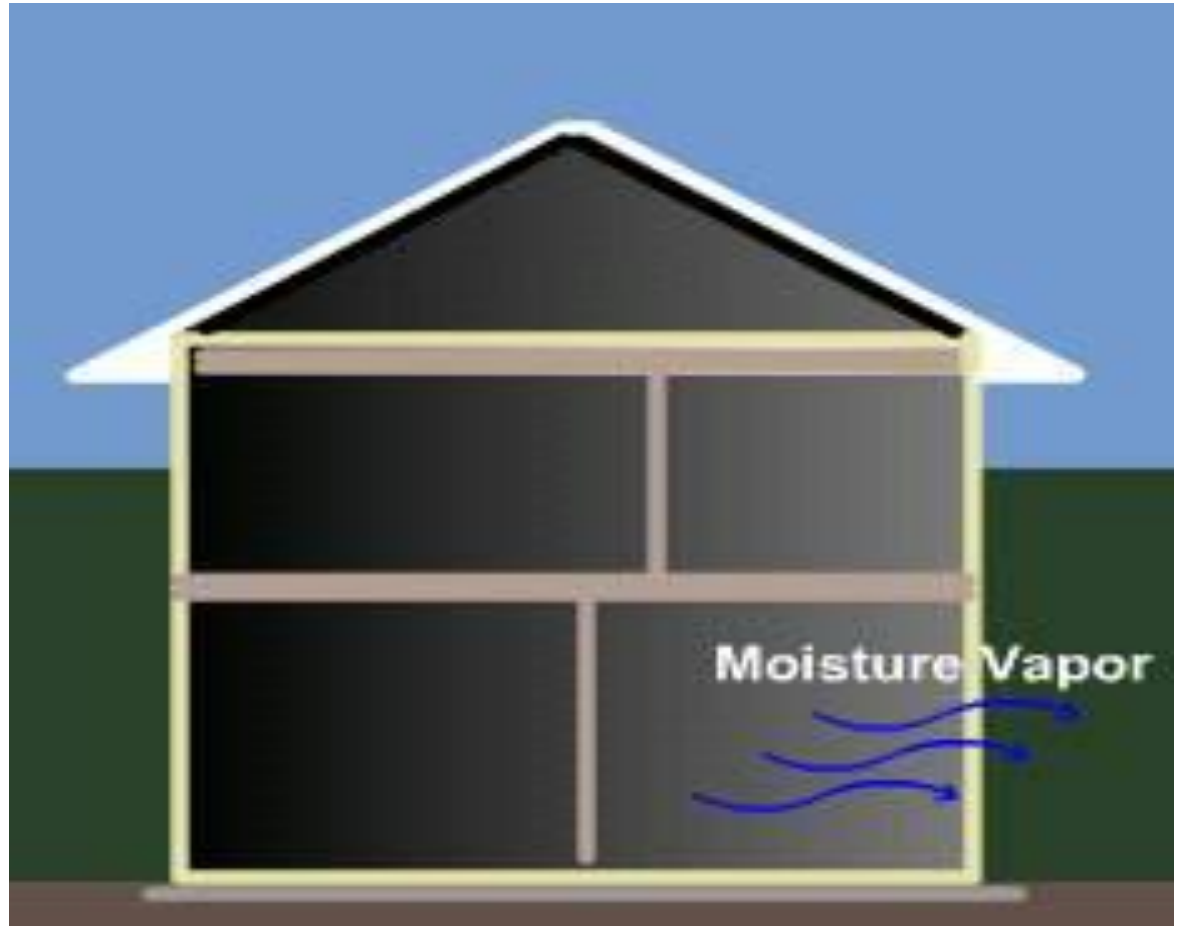
What Is Breathability?

When building materials allow for both positive and negative moisture vapor transmission, they are considered breathable.

Due to the microscopic pore structure of concrete and masonry, they are breathable in their natural state.

Water repellents are also considered breathable if they do not restrict concrete and masonry's ability to pass moisture vapor. It is essential that only breathable water repellents be applied to above-grade masonry surfaces. This is due to the significant amount of moisture generated from normal day-to-day activity.

If moisture is trapped in the substrate as it tries to pass in the form of vapor, the buildup can result in freeze-thaw damage and delamination of the coating.



Breathable water repellents allow moisture vapor to pass

Moisture Vapor Transmission: Demonstration

There are ASTM tests that measure moisture vapor transmission.

However, if you click on the adjacent image, you can watch a video that actually demonstrates it, using a tissue that has been treated with a silicone rubber water repellent. When the man blows through the tissue, you will see the moisture vapor from his breath pass through and fog the can. Note how moisture vapor can pass through the tissue, but water cannot. This is possible because a vapor molecule is minuscule in comparison to a molecule of water.

Click on the image to view the video on YouTube (no audio).

Waterproof vs. Water Repellent

The terms *waterproof* and *water repellent* are commonly used as synonyms. When discussing building design and construction, it is important to understand their differences.

Waterproof

The term *waterproofing* is most properly used to describe the process that renders building materials impervious to moisture in both liquid and vapor form.

Waterproofing is required for below-grade applications, such as a building's foundation, since a waterproof barrier can withstand the hydrostatic pressure created by groundwater. A waterproof barrier can also prevent vapor transmission.

An example of a building's foundation where waterproofing is required

Water Repellent

The term *water repellent* is properly used to describe the process that renders building materials resistant to moisture in liquid form only. Moisture vapor may still be able to pass.

However, it is important to note that not all water-repellent products allow moisture vapor to pass.

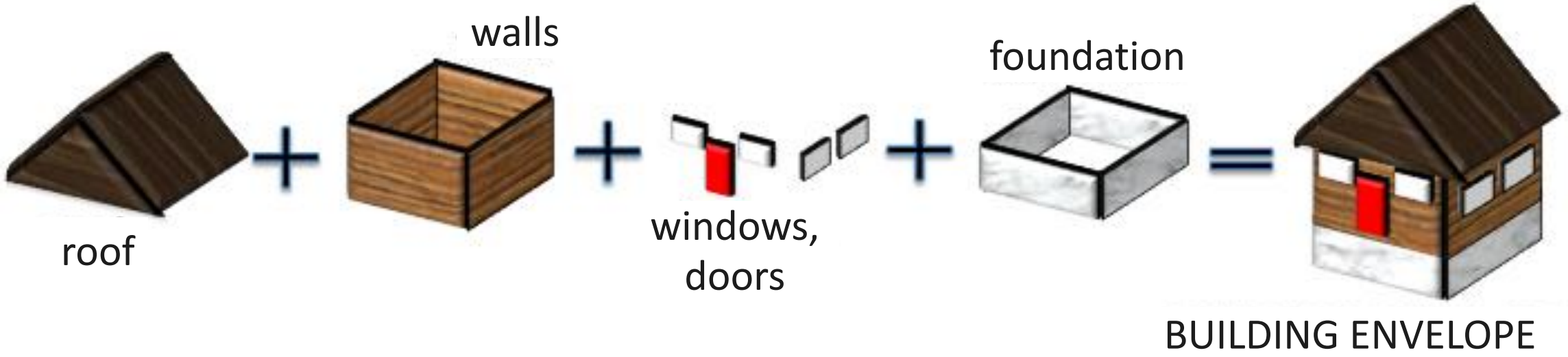
When properly applied, water repellents can help prevent the moisture-related problems created by water intrusion.

Application of water repellent to protect above-grade masonry

Water Repellent

Now that we have identified some of the damaging effects that water has on masonry, we are going to discuss the role that water repellents play in preventing them. Water repellents are one of many structural design elements that make up the belt-and-suspender system that provides a watertight building envelope.

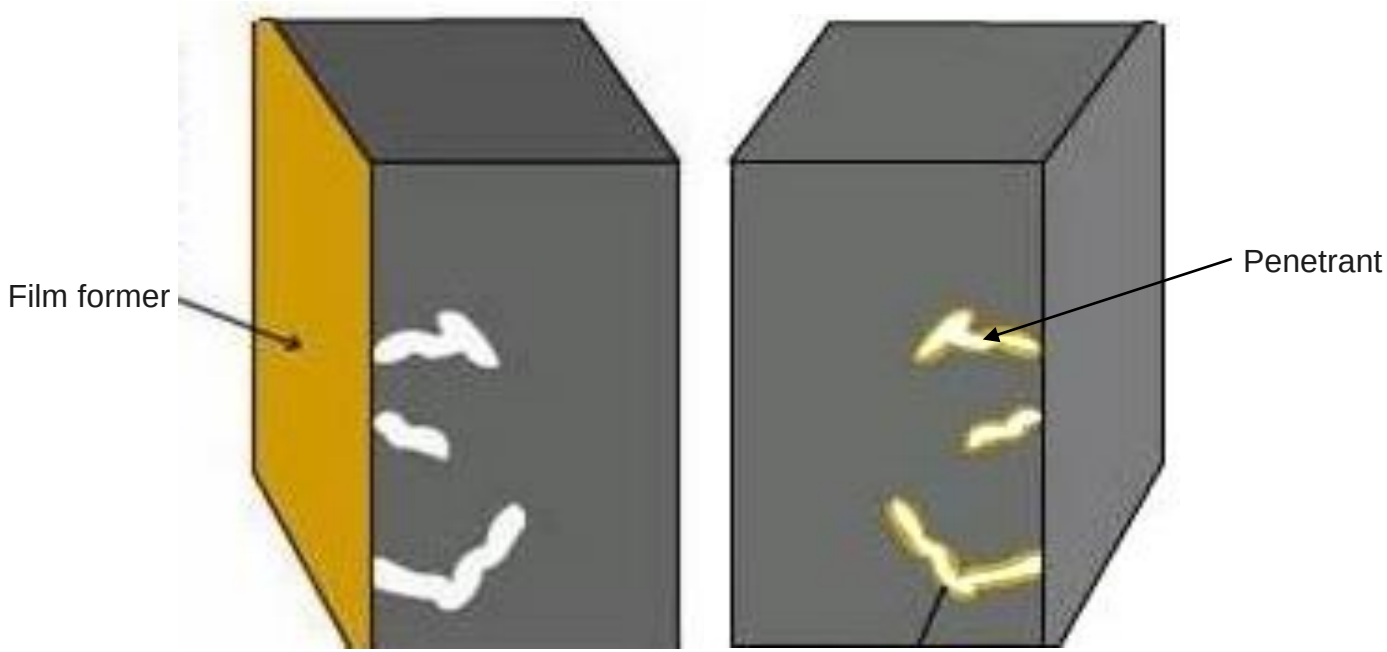
Design elements such as weep holes, cavity wall construction, and proper drainage are reactive in that they deal with water once it has passed through the masonry. Water repellents, joint sealants, and flashing, on the other hand, are proactive in that they stop the water at its source before it has a chance to enter the masonry.



Above-Grade Water Repellents

There are a multitude of water-repellent products on the market; however, they fall into two basic categories: film formers and penetrants.

While film formers and penetrants are both effective at preventing water intrusion, they differ in the way they provide this protection and how they affect masonry substrates.



Film Formers

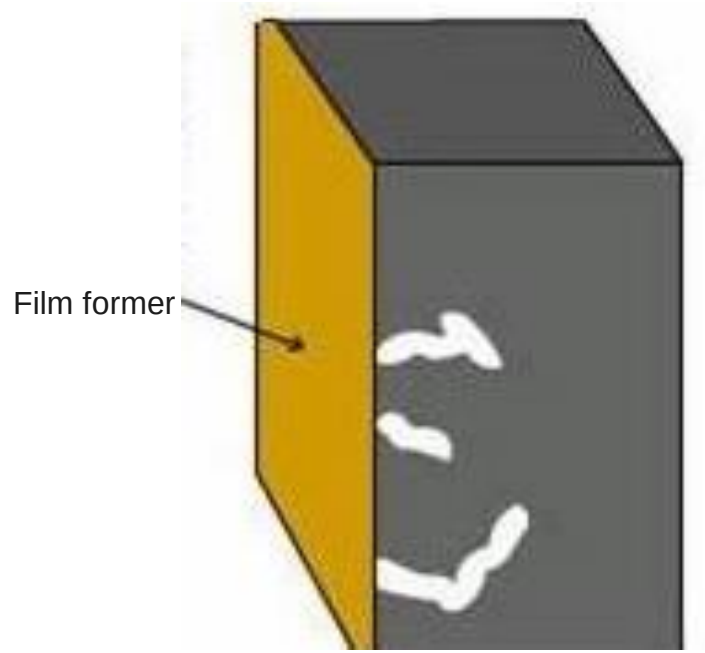
Film formers establish a protective coating on the surface of the substrate. As the solids cure, they bond together and form a water-resistant film.

Film formers are susceptible to weathering and UV degradation. They are typically nonbreathable and change the look and feel of the surface.

Since they form a continuous film, they can bridge minor structural defects and cracks.

Examples of film formers:

- Acrylics
- Urethanes



Penetrants

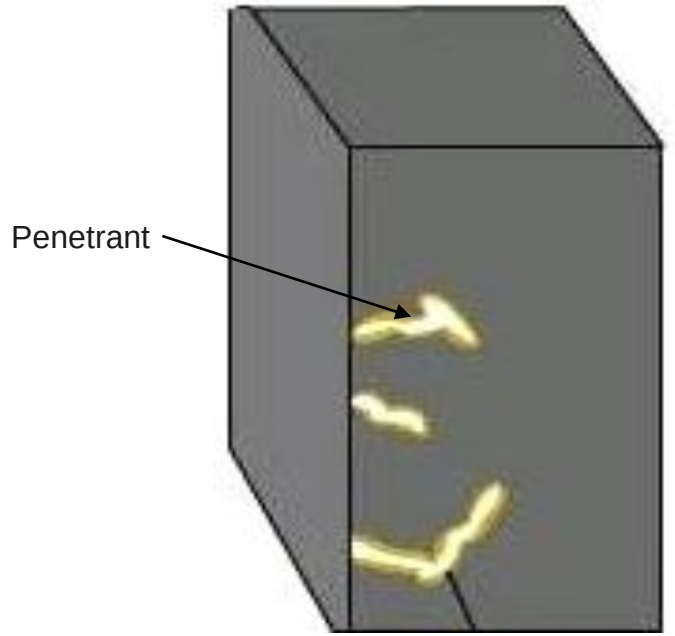
Penetrants, as their name suggests, penetrate beneath the surface, and line or fill the pores of concrete and masonry.

Unlike some film formers, penetrants are breathable and rarely alter the appearance of the substrate.

Since penetrants reside in the pore structure beneath the surface, they are resistant to weathering and UV degradation.

Examples of penetrants:

- Silanes
- Siloxanes
- Silicone rubber



Review Question

Unprotected masonry commonly absorbs water. What are some of the more common water-related problems associated with water intrusion?

Answer

Problems that water intrusion creates for masonry structures:

- Freeze-thaw damage
- Chemical- and pollution-based attacks
- Efflorescence
- Calcium carbonate stains
- Mold

Less obvious consequences of water penetration are the erosion of structural metals, such as reinforcing steel, supports, and anchors.

Silicone-Based Water Repellents

Three Types of Silicone-Based Water Repellents

1. Silane
2. Siloxane
3. RTV Silicone Rubber

These three water-repellent technologies are the most commonly specified for above-grade masonry surfaces.

They each consist of a solid component (silane, siloxane, or silicone rubber) and a liquid carrier that can be either a solvent or water.

Siloxane, silicone rubber, and silane water repellents

Silanes: Composition

Silane is derived from the mineral silica and is the active ingredient (or solids) for this type of water repellent.

Silanes have the smallest molecular structure and penetrate the deepest of the three water repellents. They are available in water- or solventborne formulations.

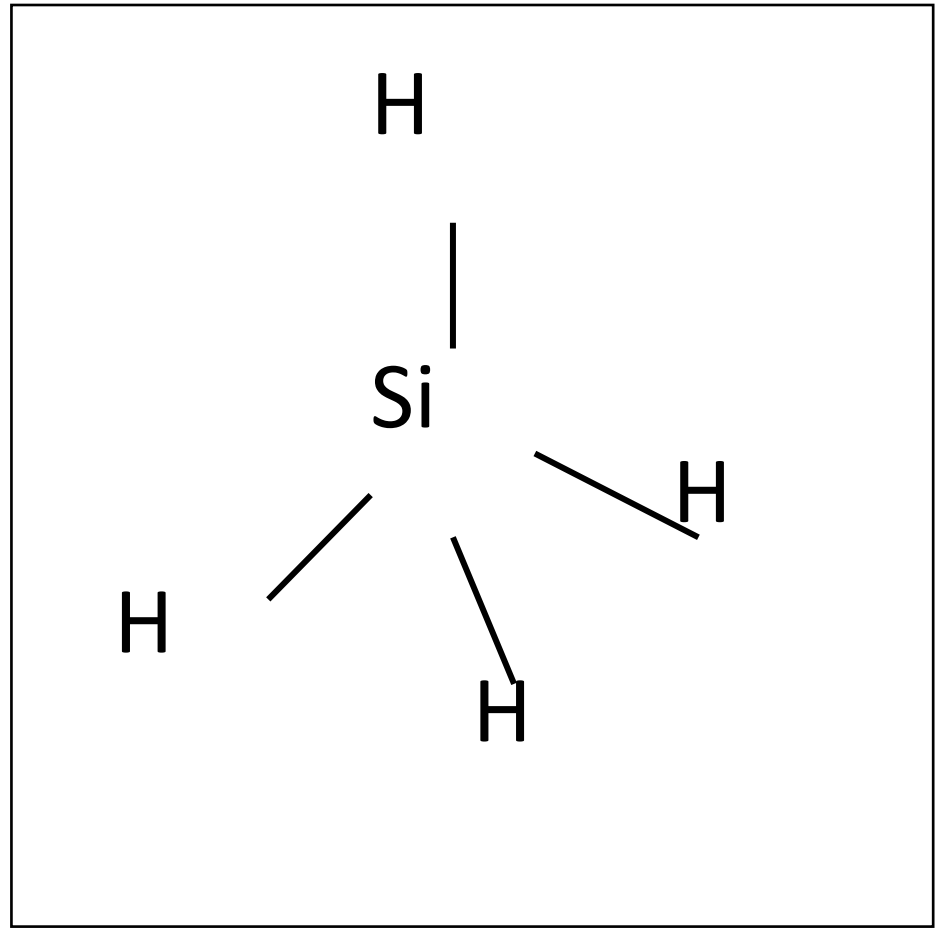
Typical formulations range between 40% and 60% solids.

Molecule model

Silanes: Mechanism of Action

When applied to masonry, the carrier transports the silane into the pore structure. In an alkaline environment, the silane reacts with silica and atmospheric moisture. The carrier evaporates, and the bonded silicone resin is formed. The resin changes the angle of the pores from absorptive to repellent, providing the water repellency.

Silanes are extremely volatile and can lose up to 40% of their solids to evaporation during the curing process. This is the reason that silane water repellents have such high solids content.



Silane structure

Silanes: Performance

Silanes are breathable in the cured state and cause little or no change to the appearance of masonry.

Due to their small molecular structure, they are most effective for dense, alkaline masonries. Silanes do not perform well on substrates that lack silica, such as wood or limestone.

Silanes lack elasticity, and as a result cannot bridge structural defects. Any minor structural defects such as hairline cracks must be addressed prior to application.

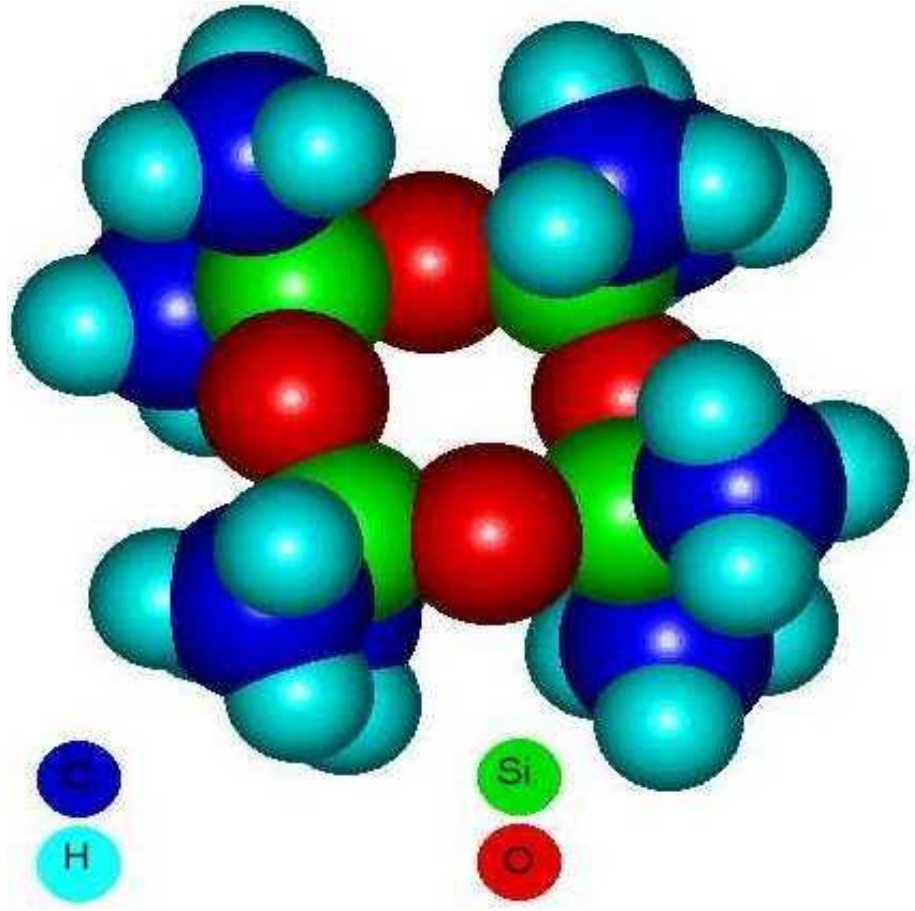
Concrete protected with silane water repellent

Siloxanes: Composition

Like silanes, siloxanes are derived from the mineral silica. Siloxanes are also available in water- or solventborne formulations.

Siloxanes have a slightly larger molecular structure than silanes and achieve good penetration into concrete and masonry substrates.

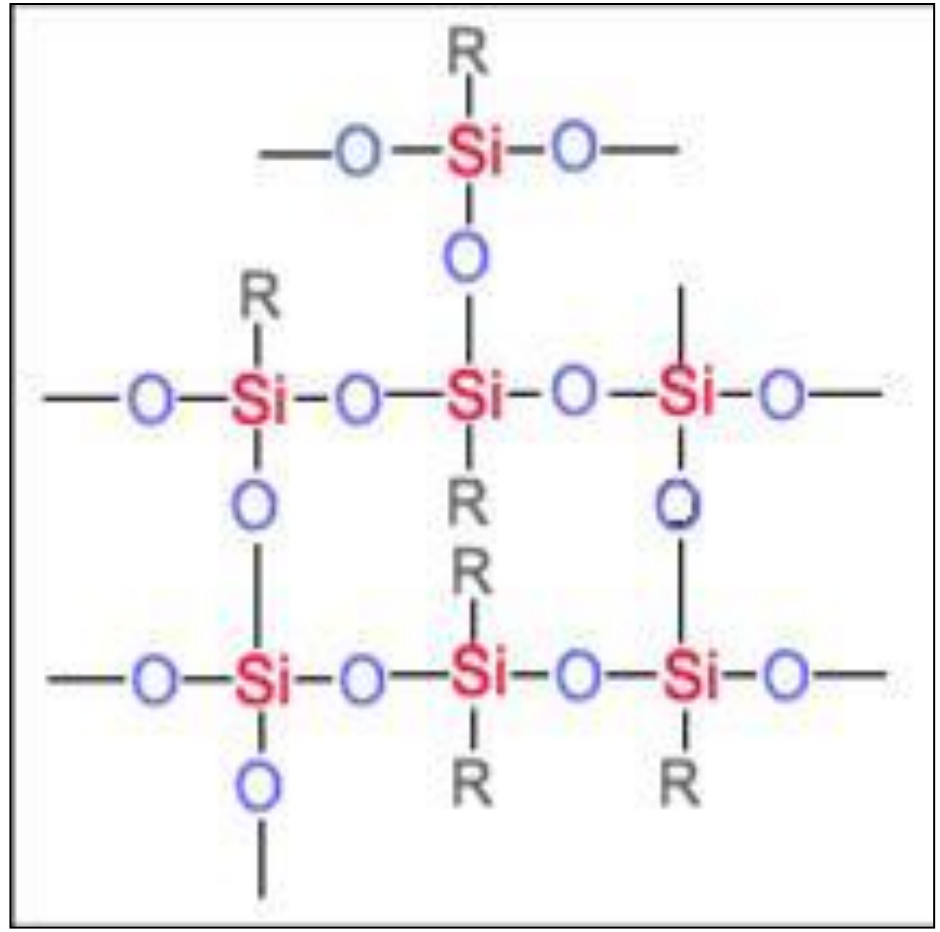
Typical formulations are 10% solids or less. Siloxanes are nonvolatile and do not require the high solids content found in silanes.



Molecule model

Siloxanes: Mechanism of Action

Similar to silanes, siloxanes react with silica in masonry and atmospheric moisture to form a bonded silicone resin that changes the angle of the substrate's pores from absorptive to repellent.



Siloxane structure

Please remember the **test password SILICONE.** You will be required to enter it in order to proceed with the online test.

Siloxanes: Performance

Siloxane water repellents are breathable and generally do not change the appearance of the substrate.

Siloxanes have a larger molecular structure than silanes. As a result, they are effective for masonries up to medium porosity, such as smooth-faced, heavyweight concrete block.

Siloxanes are not effective on natural stones that lack silica.

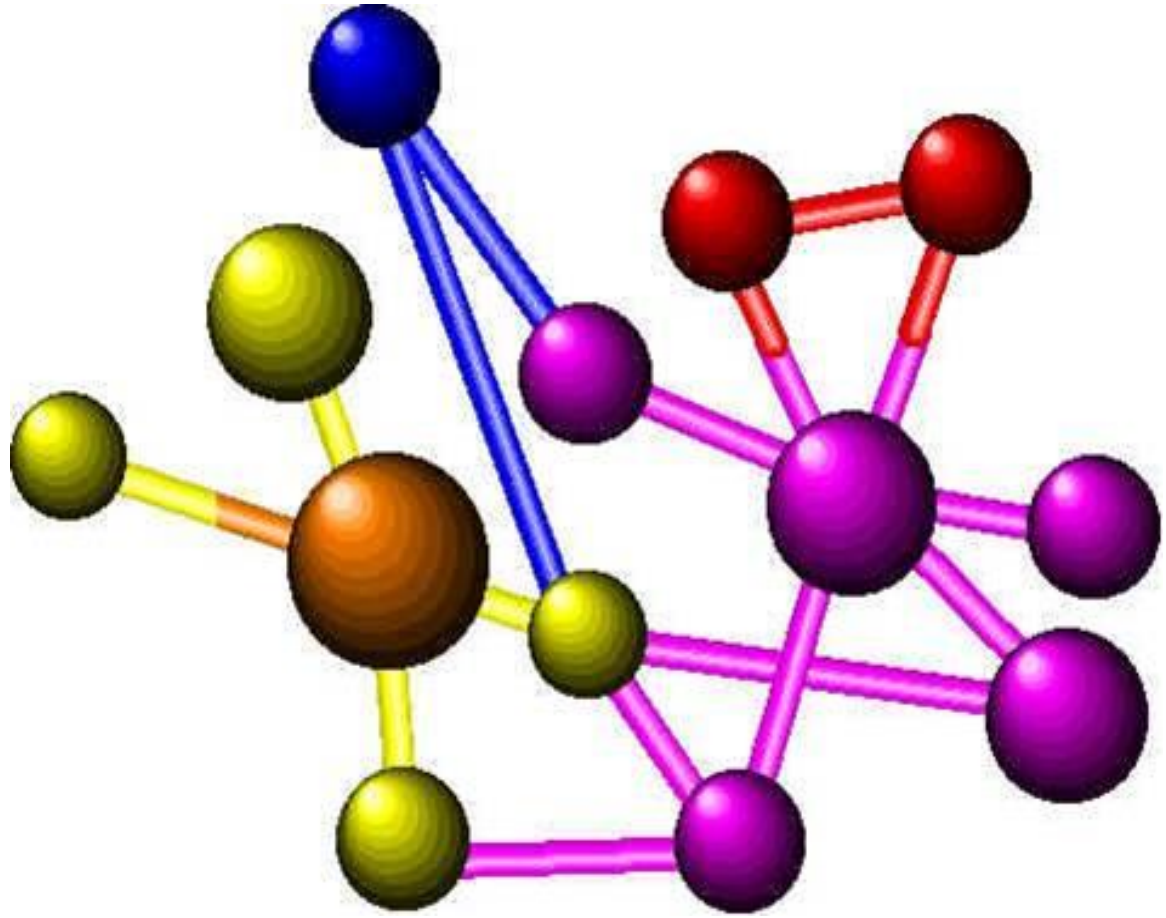
Like silanes, siloxanes lack elasticity and require that minor structural defects such as hairline cracks be addressed prior to applying the water repellent.

Brick treated with siloxane water repellent

RTV Silicone Rubber: Composition

Also derived from silica, this type of water repellent consists of room temperature vulcanizing (RTV) rubber liquefied in a solvent carrier. Since RTV silicone rubber is moisture sensitive, these products are not available in waterborne formulations.

They have the largest molecular structure of the three water repellents and are typically manufactured in formulations with solids content ranging from 5% to 15%.

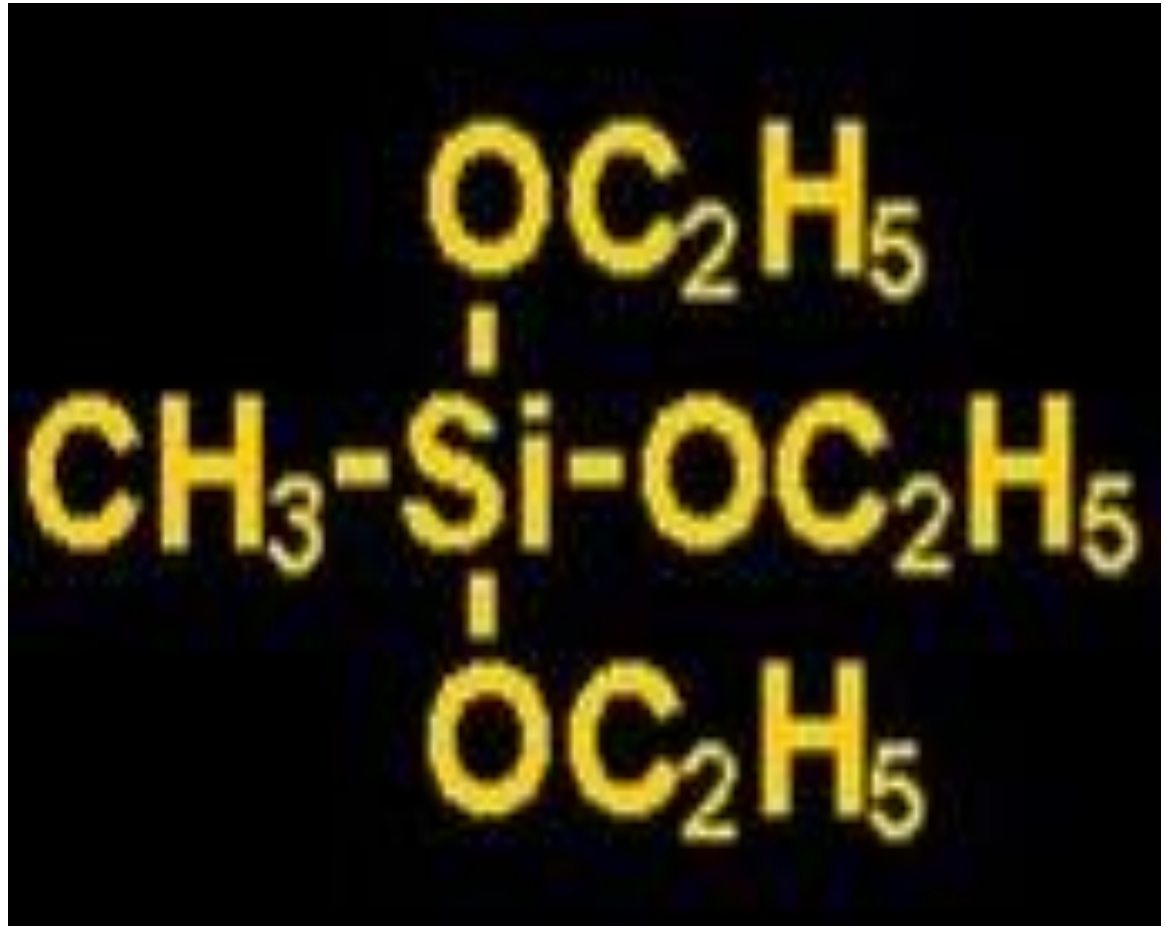


Molecule model

RTV Silicone Rubber: Mechanism of Action

When applied, the carrier transports the solids into the pore structure of the building material.

The solids absorb atmospheric moisture—which acts as a catalyst to the curing mechanism—and the solvent carrier evaporates. The solids then vulcanize, or cure, to silicone rubber within the capillary system of the substrate.



RTV silicone rubber structure

RTV Silicone Rubber: Performance

This type of water repellent is effective on a wide range of building substrates, from dense materials such as poured-in-place, smooth-faced concrete, to very porous materials such as lightweight, split-faced concrete block.

In the cured state, the silicone rubber has an elasticity of up to 400%, which allows for the bridging of minor structural defects such as hairline cracks.

Like silanes and siloxanes, RTV silicone rubber repellents allow the substrate to pass moisture vapor or breathe.

Lightweight split-faced block building

RTV Silicone Rubber

This class of repellents dries to a clear, matte finish with little or no change in the appearance of the substrate.

At higher concentrations of solids, a slight darkening or enhancement of the building material may be noticed.

After application, RTV silicone rubber is long-lasting and durable due to the long-chain polymer that forms beneath the surface.

RTV Silicone Rubber: Performance

In addition to water repellency, silicone rubber water repellents provide an effective, nonsacrificial barrier against graffiti.

Nonsacrificial means that treated surfaces can be tagged and cleaned repeatedly with no requirement to reapply the graffiti barrier. Conversely, sacrificial graffiti barriers must be reapplied each time graffiti is removed.

The graffiti barrier requires a two-coat application. Once the two coats have been applied and allowed to cure, graffiti can be easily removed using a citrus-based, biodegradable cleaner without affecting the graffiti barrier.

Key Similarities

Silanes, siloxanes, and RTV silicone rubber share some desirable characteristics.

- Penetrating: They are all penetrants that provide water repellency by lining or filling the pores of the substrate.
- Breathable: They do not restrict the ability of the building material to pass moisture vapor.
- Cure to a clear finish: There is little effect on the substrate's appearance.

Brick school building protected with water repellent

Key Differences

The differences between these three technologies lie primarily in:

- their solids or active ingredient
- their bonding mechanism, and
- their suitability for application to a given building material.

Brick school building with water repellent and graffiti barrier applied

Key Similarities

Bonding Mechanism

Silane	Siloxane	RTV Silicone Rubber
Requires silica and an alkaline environment for the chemical reaction necessary for bonding to take place. This makes it unsuitable for some types of substrates such as wood and certain natural stones.	Requires silica for the chemical reaction necessary for bonding to take place. This makes it unsuitable for some types of substrates such as wood and certain natural stones.	Bonds with or without the presence of silica. As a result, it is effective on a wider variety of building materials.

Key Differences

A building material's porosity pretty much dictates which of these products will provide adequate protection.

Although they are all effective on building materials of dense to medium porosity, only the silicone rubber water repellents are capable of sealing extremely porous substrates such as lightweight, split-faced block.

Key Differences

Silane and siloxane water repellents are available in both water- and solvent-based formulations, while RTV silicone rubber water repellents are solvent based only.

In the cured state, the silicone rubber retains the original 400% elasticity of the basic raw material, providing a crack-bridging capability that the silanes and siloxanes don't possess.

In a two-coat process, silicone rubber water repellents have proven effective at preventing paint and other forms of graffiti from bonding with masonry surfaces.

Graffiti

Review Question

The terms *waterproof* and *water repellent* are commonly used as synonyms.

What are the differences between the two terms?

Answer

The term *waterproofing* is most properly used to describe the process that renders building materials impervious to moisture in both liquid and vapor form. Waterproofing is required for below-grade applications, such as a building's foundation, since a waterproof barrier can withstand the hydrostatic pressure created by groundwater. A waterproof barrier can also prevent vapor transmission.

The term *water repellent* is properly used to describe the process that renders building materials resistant to moisture in liquid form only. Moisture vapor may still be able to pass. Note that not all water-repellent products allow moisture vapor to pass.

Other Considerations

Other Considerations

Key considerations related to water repellents:

- Application
- Volatile organic compounds (VOCs)
- Performance testing

Application of water repellent

Application Considerations

Before application of water repellents, the substrate must be properly prepared.

In general, surfaces should be:

- clean
- dry, and
- free of any other paint, sealant, or coating that could interfere with penetration and adhesion.

For specific preparation instructions, it is best to contact the water repellent manufacturer.

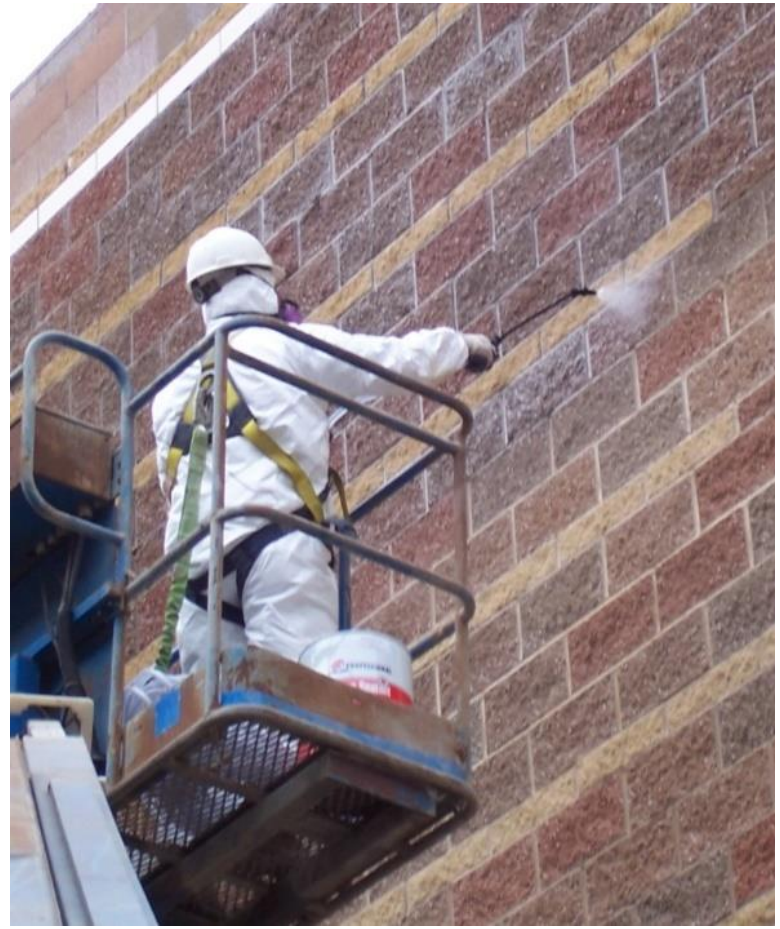
Newly constructed building awaiting preparation for water-repellent application

The Preferred Application Method

Unlike painting, where the goal is to cover the surface, water repellents are applied to the point of saturation.

For uniform coverage, it is best to apply in a saturating flood coat using high-volume, low-pressure spray equipment.

Airless spray equipment is not recommended, because there is risk of the product atomizing before it can fully penetrate and bond with the substrate.



Application of water repellent to a building using a lift

Volatile Organic Compounds (VOCs)

VOCs are carbon-containing compounds that react with oxides of nitrogen in the presence of sunlight to form smog.

They contribute significantly to the formation of ground-level ozone, which is the primary component of smog.

It has been proven that exposure to ground-level ozone is associated with a wide variety of human health effects, agricultural crop loss, and damage to forests and ecosystems.

Carbon-containing compounds react with oxides of nitrogen in the presence of sunlight to form smog

VOC Standards

VOCs are carbon-containing compounds that contribute significantly to the formation of smog.

With the goal of improving air quality and reducing harmful effects, the Environmental Protection Agency published a rule in Title 40 of the Code of Federal Regulations limiting the VOC content of 61 categories of architectural and industrial maintenance coatings.

Water repellents fall under one of these categories.

Code of Federal Regulations, Title 40

VOC Standards

The EPA has authorized individual states, counties, and municipalities to create, maintain, and enforce their own VOC regulations, as long as the standards they set are equal to or more stringent than those in the federal EPA rule.

The bluish-gray shaded areas in this map represent the areas of the country that fall under the federal regulation, while all other colored areas indicate regions that have developed their own regulations.

It is advisable to check with water repellent manufacturers to ensure products are VOC compliant in the area where the project is located.

Performance Testing

To evaluate water-repellent performance, standardized laboratory and field tests are used. A water repellent's performance can and should be evaluated prior to specification.

Examples of lab tests:

- ASTM E96 and D1653 measure moisture vapor transmission capabilities.
- ASTM E514 measures water penetration and leakage through masonry.

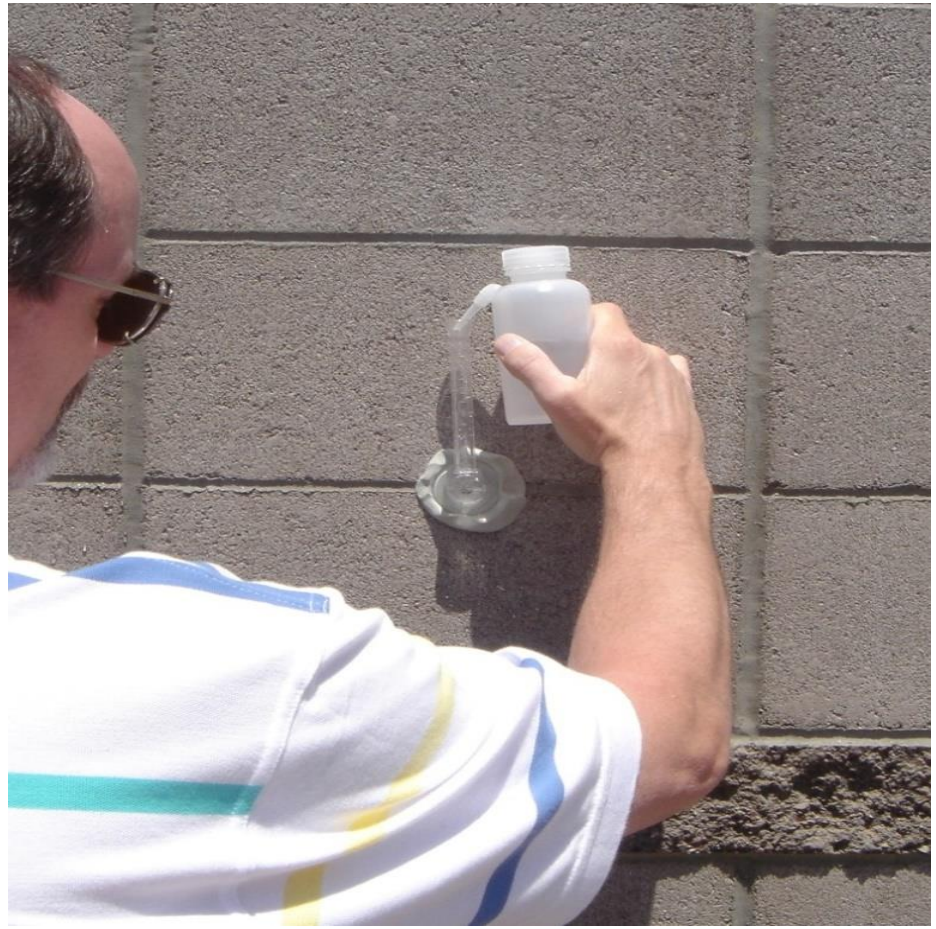
Performance characteristics can be evaluated in a lab setting

Field Testing

Field testing is the most reliable way to measure performance under actual project conditions.

Examples of field tests:

- RILEM 11.4
- ASTM C1601



RILEM test in progress

Review Question

What are the key differences between silanes, siloxanes, and RTV silicone rubber?

Answer

Only RVT silicone rubber water repellents are capable of sealing extremely porous substrates such as lightweight, split-face block.

Silane and siloxane water repellents are available in both water- and solvent-based formulations, while RTV silicone rubber water repellents are solvent based only.

In the cured state, the silicone rubber retains the original 400% elasticity of the basic raw material, providing a crack-bridging capability that the silanes and siloxanes don’t possess.

RILEM 11.4

RILEM is the French equivalent of ASTM International.

The purpose of RILEM 11.4 is two-fold:

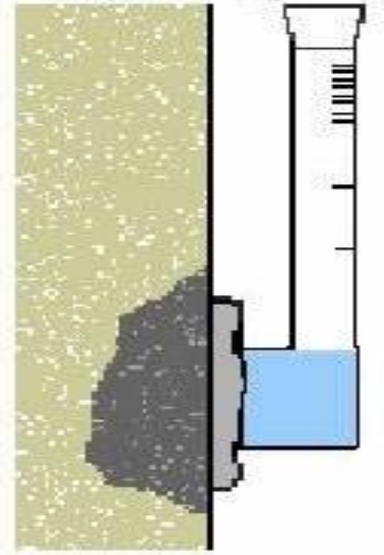
- to measure water absorption through masonry over a time-lapse period
- to evaluate a water repellent's ability to reduce the absorption rate

During the test, a tube is affixed to the surface with putty. The tube is then filled with water to simulate wind-driven rain speeds up to 98 mph.

Performance is considered acceptable when water absorption is reduced by 80% or more during a 20-minute period.

Courtesy of www.prginc.com

Illustrations of RILEM tubes



RILEM 11.4 Demonstration

Click on the image to view a demonstration of RILEM 11.4, designed to simulate a 60 mph wind-driven rain event.

In this video, you will see a very porous concrete block that has one side treated with a water repellent and the other side left untreated.

As you can see, the first test on the untreated side fails immediately.

The second side (treated with a water repellent) passes the test: no water drops during a 20-minute period.

The result is that this treated block will withstand a 60 mph wind-driven rain with no water intrusion.

Click on the image to view the video on YouTube (no audio).

ASTM C1601

Similar to the RILEM 11.4 test method, ASTM C1601 is designed to measure water absorption through masonry surfaces and evaluate the ability of water repellents to reduce that absorption rate.

During the test, a plexiglas chamber is affixed to the test area and made both water- and airtight.

Water is then pumped through a water bar located at the top of the chamber, with the concept being to create a sheet film of water over the entire face of the test area for a four-hour period.

The volume of water is measured, and the water pressure is increased at intervals throughout the test period.

At the end of the test, the water is drained from the chamber and measured. The water that was pumped into the chamber that didn’t come out has penetrated through the surface.

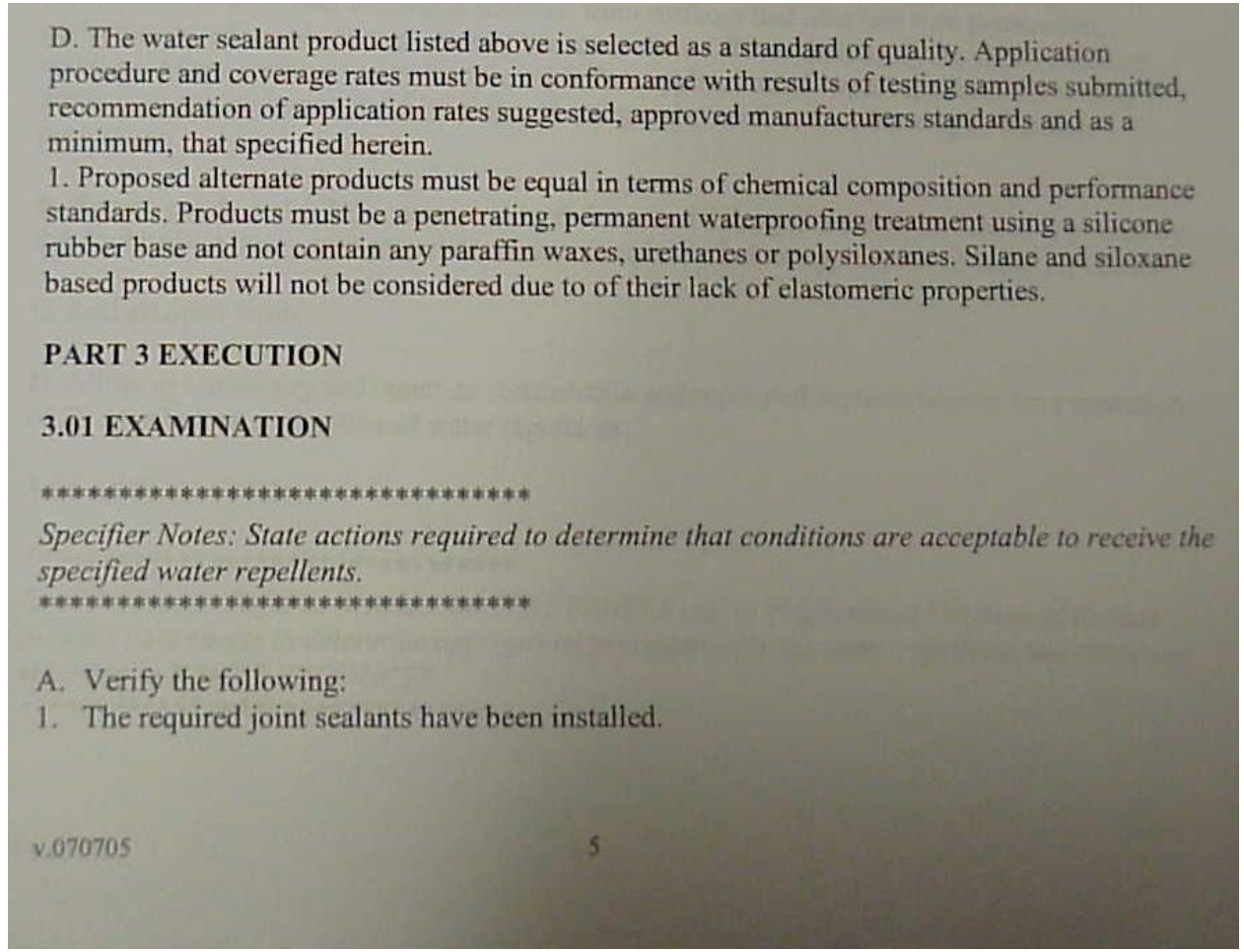
Sample of ASTM C1601 testing

Preparing the Specification

Preparing the Specification: Overview

There are certain key elements that water repellent project specifications should incorporate; they include:

- preapplication meeting
- test panel, and
- product substitutions.



D. The water sealant product listed above is selected as a standard of quality. Application procedure and coverage rates must be in conformance with results of testing samples submitted, recommendation of application rates suggested, approved manufacturers standards and as a minimum, that specified herein.
1. Proposed alternate products must be equal in terms of chemical composition and performance standards. Products must be a penetrating, permanent waterproofing treatment using a silicone rubber base and not contain any paraffin waxes, urethanes or polysiloxanes. Silane and siloxane based products will not be considered due to of their lack of elastomeric properties.

PART 3 EXECUTION

3.01 EXAMINATION

****

Specifier Notes: State actions required to determine that conditions are acceptable to receive the specified water repellents.

****

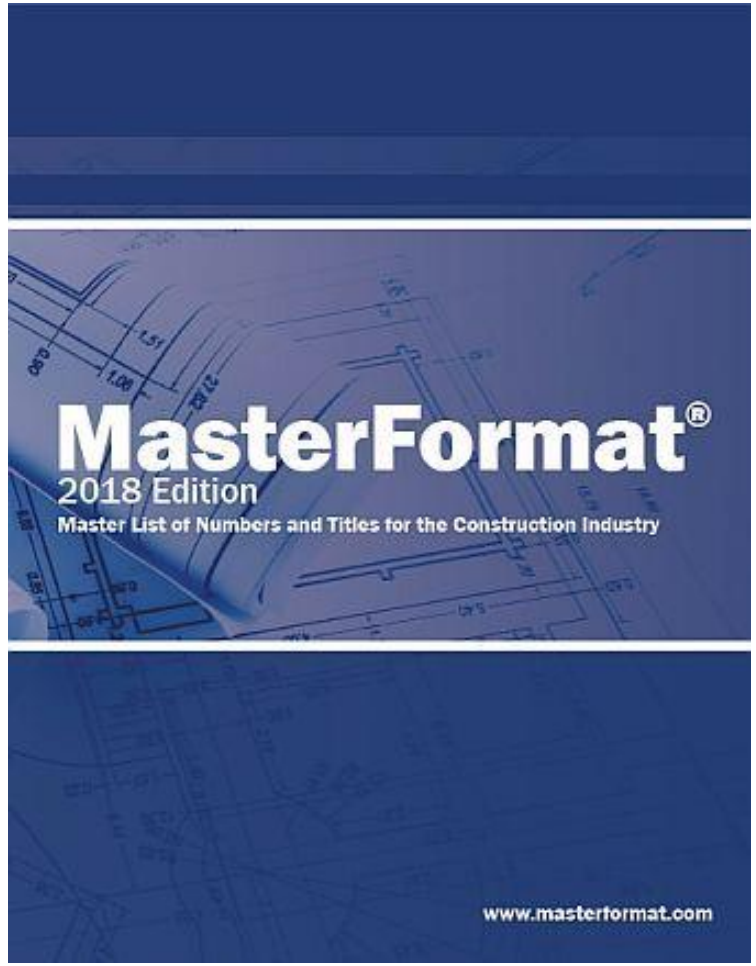
A. Verify the following:
1. The required joint sealants have been installed.

v.070705 5

CSI MasterFormat®

The Construction Specifications Institute (CSI) MasterFormat organizes building materials and requirements into numbered sections and divisions to make it easier for architects, contractors, and other users to find what they are looking for.

Above-grade water repellents appear in section 071900 of a project specification.



The Preapplication Meeting

A way to ensure that all parties involved are on the “same sheet of music” is to include a preapplication meeting section in the water repellent specification.

Who should attend:

- Architect
- General contractor
- Applicator
- Water repellent manufacturer’s representative

Preapplication meeting in progress

Preapplication Meeting Topics

During the preapplication meeting, these topics should be addressed:

- Environmental regulations
- Protection of surrounding areas and nonmasonry surfaces
- Surface preparation
- Application procedures
- On-site quality control
- Coordination with other work

There are far fewer problems on projects where these issues are covered prior to application.

The Test Panel

Incorporating a test panel section in the water repellant specification provides an opportunity to evaluate aesthetics and performance.

This section should include the requirement to apply product samples and evaluate their performance using an approved test method, such as RILEM 11.4.

The test panel should be inspected and approved by the architect prior to full-scale application.

If graffiti protection is also desired, a graffiti mock-up should be required to determine appropriate product combinations, aesthetics, and ease of graffiti removal.

Project test panel is evaluated by RILEM 11.4

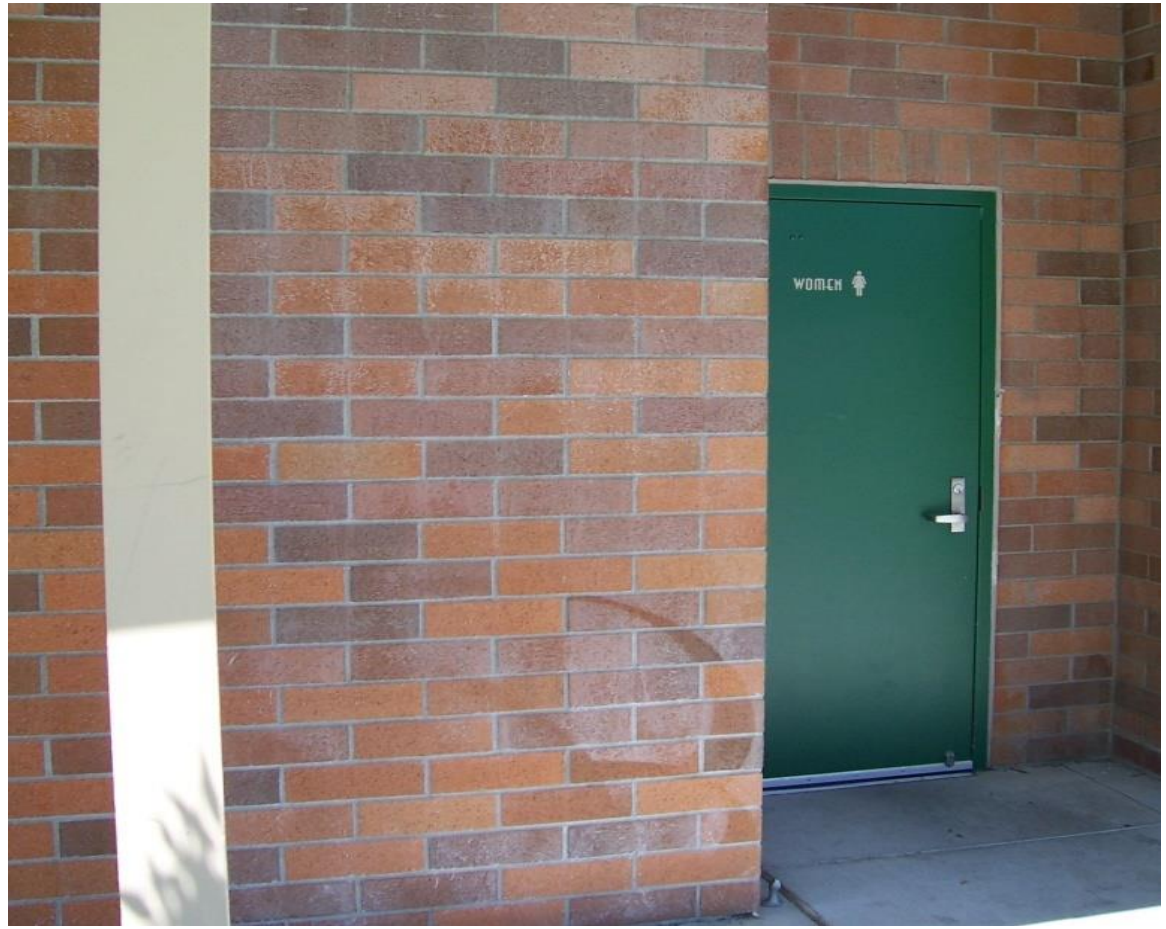
Product Substitutions

Including a product substitution section in the spec gives an opportunity to ensure that recommended alternative products are equal to those originally specified.

Their composition and suitability for the intended application should be considered.

Before substitutions are accepted, they should be applied to a test panel to evaluate and compare their performance with the specified product.

Water repellent manufacturers are generally willing to assist in these matters.



Example of a substitute product that was not suitable for the intended application

Product Warranty

The benefit of incorporating the requirement for a performance warranty in a project specification is that it gets the manufacturer and their representative involved in the project. This provides an extra set of eyes for the architect that helps to ensure that product installation is as specified.

10 Year Vertical Water Repellent / 5 Year Graffiti Protection Warranty Application

In order to receive warranty consideration, complete Sections 1 & 2 and submit for review and pre-approval prior to project commencement. Following project completion, complete Section 3 and submit entire application for processing and approval.

Section 1 *(to be completed prior to project commencement)* **Project Information:**

Today's Date:_____ Project Name:_____

Address:_____ City:_____

State:_____ Zip:_____

Owner Name:_____ Owner Phone: ( )_____

Owner Address:_____ City:_____

State:_____ Zip:_____

Architect Firm:_____ Project Architect:_____

Phone Number: ( )_____

General Contractor:_____ Phone Number: ( )_____

Section 2 *(to be completed prior to project commencement)* **Pre-Application Information:**

Estimated Application Date:_____ Application Firm:_____

Address:_____ City:_____

State:_____ Zip:_____ Project Manager:_____ Phone

Course Summary

Summary: Water-Related Problems

Common water-related problems:

- Freeze-thaw damage: Water freezes and expands in concrete and masonry, causing spalling to occur.
- Chemical- and pollution-based attacks: Carbonation weakens masonry and corrodes reinforcing steel.
- Efflorescence: Water migrates to the surface carrying soluble salts, leaving a white, powdery residue when the water evaporates.
- Calcium carbonate stains: Water migrates to the surface carrying soluble calcium hydroxide, leaving hard, encrusted streaks, commonly known as lime run.
- Mold: A woolly growth can grow on any surface that provides moisture.

Summary: Water Repellents and Breathability

Breathability is the ability of building materials such as concrete and masonry to allow both negative and positive moisture vapor transmission. Breathable water repellents are essential in above-grade applications to allow moisture vapor to pass, to prevent substrate damage.

Waterproofing is a term that describes the process that renders building materials impervious to moisture in both liquid and vapor forms. It is required for below-grade applications, such as building foundations.

Water repellent is a term that describes the process that renders building materials resistant to moisture in liquid form only, and may allow moisture vapor to pass.

Two categories of above-grade water repellents include film formers and penetrants. Film formers create a protective coating on the surface of concrete and masonry. They can restrict breathability, change substrate appearance, and are susceptible to weathering and UV degradation. Penetrants line or fill the pores of concrete and masonry. They do not restrict breathability, do not change substrate appearance, and are resistant to weathering and UV degradation.

Summary: Silicone-Based Water Repellents

Three types of silicone-based water repellents are silane, siloxane, and RTV silicone rubber. These are the most commonly specified for above-grade masonry surfaces. All three water repellents are penetrating, do not restrict breathability, and cure to a clear finish.

These water repellents differ primarily in their solids or active ingredient, their bonding mechanism, and their suitability for application to a given building material.

Summary: Other Considerations

The substrate must be properly prepared before a water repellent is applied. Generally, the surface must be clean, dry, and free of other coatings that may interfere with adhesion.

The preferred application method should include a saturating flood coat using high-volume, low-pressure spray equipment. Using airless spray equipment is not recommended due to the risk of the product atomizing before it can fully penetrate and bond with the substrate.

VOCs are carbon-containing compounds that contribute to ecosystem damage and harmful human health effects. VOC standards help limit the amount of VOCs in architectural and industrial maintenance coatings.

Performance testing is done to evaluate a water repellent's performance. An example of a lab test is ASTM E514. An example of a field test is RILEM 11.4.

Summary: Preparing the Specification

When preparing the spec for a water-repellent project, certain elements should be included, such as a preapplication meeting, a test panel, and product substitutions.

Above-grade water repellents appear in section 071900 of a project specification.

The preapplication meeting should cover topics such as environmental regulations, protection of surrounding areas and nonmasonry surfaces, surface preparation, application procedures, on-site quality control, and coordination with other work.

The test panel gives a chance to evaluate aesthetics and performance of the water repellent. An approved test method such as RILEM 11.4 should be used. The test panel should be inspected and approved by the architect before full-scale application.

A product substitution section helps to ensure that substitute products are the same as those specified. Before accepting a substitute, it should be tested on a test panel along with the specified product to compare their performance.

Conclusion

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