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Problems

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Effects Of Temperature On Sealer

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SEALER SERIES Part 1: The Different Choices

By Chris Sullivan – ChemSystems, Inc.

Sealers, and the problems associated with them, continue to be the biggest source of frustration for decorative concrete applicators around the country. It's easy to understand why: There are a vast number of sealer products on the market for decorative concrete, yet many contractors lack a basic understanding of how to select and properly apply the products. This series of blog articles will address the most common sealer problems encountered in the field, why they occur, and how to avoid and repair them.

Before we can get into dealing with problems, it's necessary to give you some background on the products being used. I am continually amazed at how many applicators I talk to that know very little about the sealer they have been using for years (other than the color of the can it comes). While most sealers straight out of the container look, smell and flow similarly, there are major differences. Here's brief overview of the four types of sealer products used for decorative concrete. All have a different function, purpose and recommended method of application.

Cures are designed to slow initial hydration of concrete to create a stronger product and minimize shrinkage cracking. However, they are not intended to provide long-term durability and protection. They are applied as soon as the freshly placed concrete can be walked on, and they can be tinted to match colored concrete.

Sealers provide long-term protection and color enhancement. But they should not be applied until after concrete has cured. The recommended minimum curing time is 28 days, but most contractors typically wait only 7 to 14 days. View this comparison chart of concrete sealers.

Cure and seals, as you might expect, blend some of the benefits of cures and sealers. Like cures, they slow initial hydration of concrete to create a stronger product and minimize shrinkage cracking. They also provide mid-term protection of 6 to 12 months. These products are applied as soon as the concrete can be walked on.

Coatings provide long-term protection, the best chemical resistance, and color enhancement. Like sealers, they must be applied after the concrete has fully cured (28 days). They may also require special surface preparation for proper adhesion.

Note that cures, cure and seals, and straight sealers all have a dry film thickness of about 1 mil and are breathable. Coatings are thicker (2 to 3 mils) and typically no breathable. Even with so many options and chemistries, the problems I see with these products, such as environmental impact and application issues, are similar no matter what product is used.

SEALER SERIES Part 2: VOC Regulations – How They Affect the Products You Use

By Chris Sullivan – ChemSystems, Inc.

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids, including many types of sealers. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. In addition to sealers, VOCs are emitted by a wide array of products including paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials, and even furnishings.

Depending on the environmental regulations in effect where you work, VOC limits range from 100 to 400 grams per liter. The typical VOC content in solvent- and water-based concrete cures, cure and seals, and sealers ranges from 100 to 780 grams per liter. It is your responsibility to use a product that meets VOC guidelines. Consult your regional EPA office or local government environmental office to obtain the VOC limits in your area.

Not all solvents are considered to be a VOC. The government uses a complex formula to determine which solvents are harmful. As local, state and federal governments clamp down on VOC emissions, manufacturers are being forced to reformulate their products to bring them within VOC tolerance (or eliminate them from the market altogether). This means that the sealers and coatings you are accustomed to applying may have changed in formulation. The most common change has been a reduction in xylene (a VOC producer) and an increase in acetone (a non-VOC producer). While this switch has virtually no effect on the performance of sealers and coatings, it can have other consequences, such as making the product difficult to roll out, faster drying times, an increase in spider webbing, surface blistering, and an increase in cost. We will discuss these issues more in later installments.

SEALER SERIES Part 3: Preventing Moisture Problems

By Chris Sullivan – ChemSystems, Inc.

Moisture is a leading cause of problems with decorative concrete sealers. Under certain conditions, moisture can become trapped in or under the sealer, resulting in whitening or clouding of the sealer membrane. But why does this happen, how do we avoid it and how do we fix it?

Whitening of sealer is often caused by applying it to a wet surface.

There are two key contributors to moisture problems. The first is sealer contact with moisture in the concrete during application. Cures, cure and seals, and sealers for decorative concrete (see Part 1 for the differences between these product categories) are all designed to handle different levels of moisture contact. Cures and cure and seals can handle higher levels of moisture contact, allowing them to be applied to green (high-moisture-content) concrete and not turn white or cloud up. Decorative concrete sealers, on the other hand, can't take much moisture contact. This is why they need to be applied after the concrete has cured for 28 days. If a decorative sealer is applied to green, or wet, concrete, you can pretty much guarantee the development of a nasty white haze. This has to do with the type of resin (or plastic) the coating is made from, and how that resin deals with moisture contact.

The second key contributor to moisture problems is the permeability of the sealer, or how readily water is able to pass through the sealer membrane. Permeability is directly related to the solids type and content and thickness of the sealer. All exterior acrylic cures, cure and seals, and sealers are designed to allow some level of permeability when applied at 300 to 500 square feet per gallon. The lower the solids content and/or the thinner the membrane thickness, the more moisture that can pass through the sealer without getting trapped and turning white. This is why applying sealer at the proper thickness is so important, especially when dealing with high-solids-content products (in excess of 25%). The higher the solids content, the smaller the margin of error. Most of the moisture-related problems I see in the field are caused by over application of high-solids cure and seals or sealers.

In regard to avoiding moisture-related problems, it is really quite simple. Use a sealer with a solids content of less than 25% and apply it thinly by spray. If problems do occur, misting solvents over the surface, such as acetone, xylene or MEK (methyl ethyl ketone) followed by back rolling will spread out the sealer film and remove excess material. After the solvents evaporate, the sealer will reharden. In a worst-case scenario, it may be necessary to strip off the sealer followed by cleaning of the surface and sealer reapplication.

SEALER SERIES Part 4: The Effects of Deicing Salts on Sealer Performance

By Chris Sullivan – ChemSystems, Inc.

Sealer failure caused by deicing salts often starts out with a white, hazy appearance, similar to what you see when moisture is trapped by the sealer. But actually a very thin air gap has formed between the sealer and concrete due to water pressure. Eventually, the sealer will pop off the surface.

First, the good news: Deicing salts have no direct effect on sealers. In fact, concrete sealers of any type have been proven to increase the lifespan of salt-treated concrete three to five times! Now the reality: Sealers for decorative concrete often fail in areas where deicing salts are applied or that receive drip-off from parked cars. It's not the salt, though, but rather what the salt is doing that causes the sealer to fail.

Salt chemically reduces the temperature at which water freezes. When salt is applied to a sealed decorative concrete surface covered by snow and ice, it causes melting and turns the frozen water into a liquid that is now able to migrate into the concrete. This salt-rich water (brine) goes through many freeze-thaw cycles as environmental conditions change (i.e., more snow falls, the sun comes out, more salt is applied, the temperature changes, etc.). So instead of one freeze-thaw cycle per day (or season, the farther north you live), it's possible to have hundreds per day when salt is used. During each cycle, the water expands as it freezes and thaws as it contracts. The problem is that while sealers help to retard moisture movement, they do not stop it completely. So as the saltwater passes through, under and all around the sealer, the water is expanding and contracting, and eventually the sealer will fail.

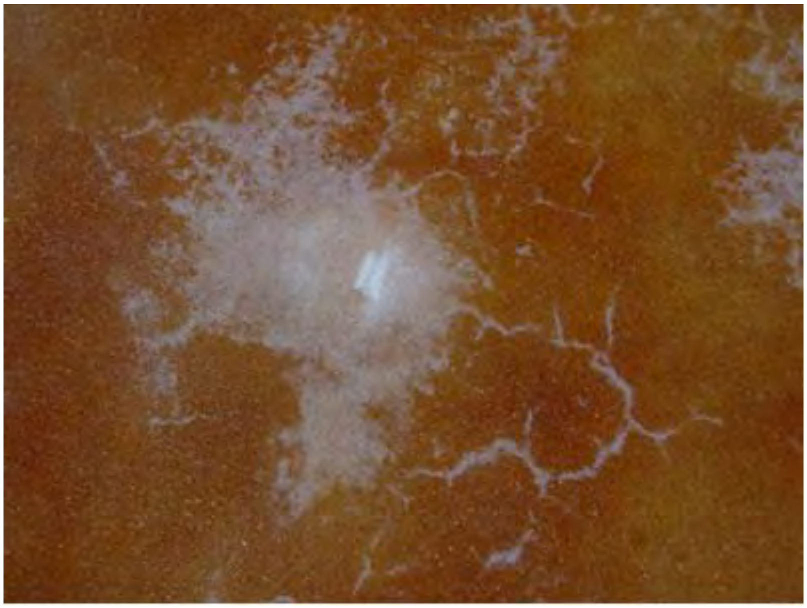
Think about what happens when you bend a steel wire. The first time, not much. But when you bend the wire 50 times, it's likely to snap. A sealer can only take so much pressure from water expansion and contraction before it snaps and pops off the surface. The same process is what causes the top layer of concrete to pop off (commonly referred to as spalling or surface delamination) in high-salt-use areas.

The best offense against sealer failure due to deicing salt use is a good defense. In areas with severe winters, some contractors use a combination of sealers to fight the effects of deicing salts. They start with a penetrating sealer (silane, siloxane or silicone) that fills the concrete pores from the bottom up. Then they apply an acrylic sealer for decorative concrete that creates a membrane from the top down. This systems approach costs a bit more, but when faced with stripping and resealing, it may be well worth it.

SEALER SERIES Part 5: The Effects of Temperature on Sealer Reactivity

By Chris Sullivan – ChemSystems, Inc.

The No. 2 cause of problems when applying sealers to decorative concrete (after moisture) is temperature. Both air and surface temperature play a role, but surface temperature is typically more critical. After application, sealers undergo a chemical reaction that causes them to cure and form a film. Temperature plays a critical role in how fast or even whether this reaction occurs. The best temperature range for applying sealers is 50 to 90 degrees F. That 40-degree window is really not very big, especially when you're working outside. This is why monitoring weather conditions and looking at a thermometer should be mandatory before every sealer application. Here's what can happen if temperatures are too low or too high.



When temperatures are too cold during sealer application, a film won't form and you're left with a white, powdery residue.

Low temperature

Every sealer has a minimum film forming temperature (MFT), or the minimum temperature needed for the sealer to properly form its film, cure, and get hard. For most sealers, this temperature is around 40 to 45 F or higher. To be safe, most sealer manufacturers specify 50 F to provide a buffer zone. If the temperature is at or slightly below the MFT, the chemistry of the sealer is affected, the reaction slows down, and you get partial to no film development. Bottom line: The sealer is weak and will not hold up very long. If the temperature is really cold, film development stops altogether and all you are left with is a white powder on the surface after the carrier (solvent or water) evaporates.

High temperature

Temperature is a catalyst. As the temperature increases, so does the reactivity of the sealer. Increased reactivity decreases the working time, or pot life, of the sealer. The faster the reactivity, the less time the sealer has to wet out the surface, de-gas, and form its film. This makes it critical to get the sealer down on the concrete quickly and efficiently. As the temperature increases, the ability to roll out sealers becomes more difficult. I always recommend spraying solvent-based sealers, especially in warm conditions (see Summer Sealer Basics). A common indication that the temperature is too high is the formation of fine "spider webs" or "cotton candy" strings coming off the roller or spray tip. This occurs when higher temperatures cause the solvent to flash before the resin (plastic) in the sealer can form its film. The pressure from the sprayer or friction from the roller pulls the soft plastic into long, thin strands.

Another common issue caused by higher temperatures is the formation of bubbles or blisters in the sealer. They occur when the solvent flashes too fast, trapping gas and air in the sealer. With today's tightening VOC requirements (see Does the Voc Content of the Sealer You're Using Meet Current Federal and Local Regulations?) more fast-flashing solvents are being used, which makes the window of application even smaller. When outside temperatures are expected to rise above the recommended application range, apply the sealer during the cooler times of the day, typically mornings and evenings.

SEALER SERIES Part 6: Dealing with Condensation on Sealers

By Chris Sullivan – ChemSystems, Inc.

We have covered how moisture (Part 3) and temperature (Part 4) can each affect sealer performance. But what happens when both come into play? Here's a mini lesson in meteorology to explain the problems that can occur when the two conspire.The air that surrounds us always contains water vapor, but the amount of water can vary. Humidity is the measure of how much water is in the air at any given time. We would not have to worry about this water vapor if it just remained trapped in the air as a gas. But it doesn't because temperature fluctuations convert that water vapor into a liquid. If temperatures rise and enough water is in the air, instability is created and rain can fall. As temperatures fall, condensation can occur in the form of dew. For example, on cool summer nights, you'll often see dew-covered cars, grass, and other surfaces once morning comes around. The dew point is the temperature at which water comes out of the air and becomes a liquid.

Water that condensed on a stained concrete floor by a cold doorway caused the sealer to white out in that area.

What does all this have to do with sealers and decorative concrete? A lot, if not taken into consideration before sealing. As humidity increases and temperature decreases, water will condense on cool surfaces. Since concrete is a sponge, it will absorb the condensation. The problem is that the slab surface won't look wet, but hiding just beneath it can be lots of collected water. If a sealer is then applied to the surface, the trapped water can cause the sealer to white out or not adhere properly. Outdoors, this problem is more common during transition seasons (spring and fall) as nights get colder but humidity is still high during warm days. Indoors, this problem is prevalent in the winter near walls and doors where floor temperatures are colder.

SEALER SERIES Part 7: Preparing Surfaces for Sealer Application

By Chris Sullivan – ChemSystems, Inc.

A simple but often overlooked step in any sealer application is surface profile. When I use the term "surface profile" in regard to sealing, I am including all aspects of the surface at the time of sealer application. But the two heavy hitters are cleanliness and porosity. Overlooking either can cause even the best sealers to fail.

Clean means just that: clean! A surface that is to be sealed must be free of all dirt, dust and any other contamination that will come between the sealer and the surface. Just spending a little extra time cleaning can make all the difference in how well the sealer adheres. In some cases, a good broom or blower is all that is needed to remove loose dirt. More stubborn contaminants may require removal by scrubbing with soap and water followed by a clean water rinse or acid etching followed by neutralization. I also consider residue from stain and dyes, excess release powder and efflorescence as surface contamination. These types of dry contamination are most often the culprits when sealers fail due to a dirty or contaminated surface. Efflorescence and stain residue are especially nasty because their extreme pH levels can affect sealer chemistry. A sealer that exhibits white "curds" in the film or soft spots is often failing due to a surface pH imbalance.

Porosity refers to the concrete surface's ability to take in the sealer. If the sealer can't wet out there will be little or no adhesion and durability. A hand-troweled concrete surface is usually porous enough to accept a one-part sealer with a solids content lower then 30%. A machine-troweled concrete surface will usually require additional prep to open it enough to accept the same sealer. Typical methods for opening a very tight or dense surface include light sanding or acid etching. When dealing with higher-solids sealers (usually two-part polyurethanes and epoxies with solids in excess of 45%) opening the surface or diluting the first sealer coat is highly recommended. A simple water test (to see how well the water wets out the surface) is a great way to determine if the surface is ready to accept the sealer.

As with any sealer, always refer to the manufacturer's installation guidelines for specifics on surface preparation and proper application techniques.

SEALER SERIES Part 8: Choosing the Best Applicator

By Chris Sullivan – ChemSystems, Inc.

How a sealer is applied can affect the final outcome and performance as much as all the environmental factors discussed in this series combined. Using the right tools is critical to achieving the best coverage rate and sealer thickness for optimal performance. While there are some general rules or guidelines for applying sealer, you should always refer to the manufacturer's installation instructions to see what they recommend.

The most important rule to remember is that less is more. You should apply sealer in multiple thin coats vs. one thick heavy coat. To get this liquid sealer down on the surface in the most efficient manner—and give it the best chance to harden and not fail—you need to ask yourself the following questions:

- Is the sealer solvent- or water-based? The liquid component of the sealer will determine how fast it evaporates.
- What is the solids content (usually stated in percent solids)?
- What is the resin type—acrylic, polyurethane, epoxy?

The answers to these questions will help you choose the applicator type best suited for the product you are using.

LPHV (low-pressure, high-volume) or airless sprayers: These sprayers are usually the best way to apply any sealer. They permit very controlled application rates, allowing large areas to be sealed in the shortest time. They will also handle both water- and solvent-based sealers, high and low solids contents, and any type of resin. The downside is the cost, since this spray equipment can be expensive. You may want to consider renting.

Pump-up or low-pressure sprayers: These are best for applying one-part, solvent-based sealers with a solids content below 35%. Make sure to use a sprayer that can handle solvents, and clean out the sprayer with clean solvent to avoid clogging the lines.

Roller: A paint-type roller with a 1/4- to 3/8-inch nap can be used to apply both water- and solvent-based sealers. However, when the solids content is high (above 35%), rolling becomes a problem for solvent-based sealers. Rough surfaces and high temperatures can also present problems when rolling solvent-based sealers due to puddling and surface bubbling. Consider spraying followed back rolling when sealing stamped or textured surfaces with a solvent-based sealer.

Lamb's wool applicator: This is basically a wool rag wrapped around a wooden block. It's great for applying high-solids (above 35%) solvent-based sealers, especially polyurethanes and epoxies. But its use is limited to smooth surfaces because the applicator will not run over a rough surface.

T-bar: A metal straight edge used to pull very high-solids-content (35% +) polyurethane and epoxy sealers across smooth surfaces.

Micro-fiber applicator: This synthetic-fiber pad (Padco Floor Coaters) is best for applying water-based low-solids sealers on smooth surfaces and is a great way to achieve very thin coverage. Push and pull the sealer around, maintaining a wet edge.

Synthetic closed-loop mop: Use this applicator for water-based finish sealers (waxes) only. Move the finish around with the mop, maintaining a wet edge.

SEALER SERIES Part 9: Sealer Application Tips

By Chris Sullivan – ChemSystems, Inc.

Each type of sealer has a recommended applicator and coverage rate, as discussed in Part 8: Choosing the Best Applicator. But simply using the right application tool won't guarantee good results. You also need to practice the proper application techniques to avoid bubbles, blisters, lap lines and other eyesores.

The most common application problem is applying too much sealer at once (remember the phrase "thin to win"). Sealers are designed to perform best at a specific thickness, depending on the type of resin. This is determined by the coverage rate for that particular sealer. A good analogy is to compare sealers to a deck or cards. The first and second cards dealt are close to the surface, hard to pick up and very stable. The more cards you put on the pile, the more unstable the pile gets. The same holds true for sealers. The first and second thin coats are very stable, have good adhesion and provide good durability. The more you apply, either in one or multiple applications, the more unstable the system gets. With solvent-based systems, the signs of overapplication are typically bubbles, blisters and white haze. With water-based systems, you'll often see blisters, foam and a milky white cloudiness.

Another common application mistake is lap lines, or uneven application. When applying sealer, always go back over the previous pass about 2 inches as you move across the surface. This overlap needs to occur when the sealer is still wet, so the two passes blend and become one. If the first pass dries, the second creates a lap line and can be seen after the entire floor is dry. Fixing the problem usually requires applying another full coat of sealer.

When applying sealer by sprayer (whether using an LPHV, airless or pump-up type) make sure to maintain constant pressure and use the proper tip. A cone-shaped spray pattern is better than a fan pattern, and the more atomized the sealer the better.

When applying sealer by roller, make sure to buy a roller suitable for the sealer type (water- or solvent-based) and a nap thickness appropriate for the surface. When rolling on water-based sealers, be careful not to over-roll, which can causing foaming and blisters. You also may need to dip the roller more often. Some newer acetone-based fast-drying sealers can't be roll applied because they flash off too fast.

When using a lamb's wool applicator, micro-fiber applicator, synthetic mop or T-Bar, the application process is the same. Pour the sealer on the surface, and push and pull the product while maintaining a wet edge until you achieve the desired thickness. These application methods are very good for water-based sealers because they don't foam and you can see the white sealer go clear as you push and pull it around the floor. However, they will only work on smooth floors.