SINAK

SUSTAINABLE BUILDING SOLUTIONS

THE ARCHITECT'S GUIDE TO CONCRETE

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By understanding the chemistry and behavior of concrete, and familiarizing yourself with as many of its resulting conditions as possible, you can easily prevent problems during placement or often mitigate the resulting issues after the installation process.

Concrete does not come in a bag. While it is true that you can go buy it at a big box hardware store, concrete is much more than a bagged product. It is essential to obtain a basic understanding of concrete's nature and behavioral characteristics to better understand the problems that arise on jobsites.

Concrete is a complex three-dimensional dynamic building product. According to ACI 116, "Concrete is a composite material that consists of a binding medium within which are embedded particles or fragments of aggregate, usually a combination of fine aggregate and coarse aggregate." Portland-cement combined with water and (sometimes) admixtures is the most commonly used type of concrete. When all ingredients are combined, a one-way linear chemical reaction begins. This linear reaction can be sped up, slowed down, or stopped, but cannot be restarted. Each step in this linear process is important and requires time to react and behave properly.

The purpose of this guide is to provide a basic knowledge of concrete, its behavior, how it functions from a scientific perspective, and to shed light on what can go wrong during concrete installation and how to prevent it. The examples provided in this guide are real conditions that occur when concrete is not installed as designed. Please note that, while every effort has been made to ensure the specific cause and effect is listed for each example provided, multiple conditions may apply to the following problems. It is best to recognize that there is rarely one cause for a problem. Typically, it is a combination of errors that lead to an issue. However, by better understanding the chemistry and behavior of concrete and addressing as many conditions as possible, you can prevent problems during placement or mitigate the resulting issues after the installation process.

TERMINOLOGY AND DEFINITIONS

▶ Every industry develops a form of communication built around industry-specific terms. Contractors and construction personnel, for example, use their own jargon. Understanding these terms and knowing how to use them helps to improve communication and reduces conflict. By establishing ground rules and providing this list of definitions, projects will progress more smoothly and result in improved concrete quality.

TEST YOUR KNOWLEDGE

Q: Which rule states that—with given concrete materials and conditions of tests—the ratio of the amount of water to the amount of cement in the mixture determines the strength of the concrete (provided the mixture is of a workable consistency)? ***Hint:*** We commonly refer to this as the "water-to-cement ratio

A: Abram's Law

ADMIXTURE: a material other than water, aggregates, hydraulic cement, and fiber reinforcement, used to modify concrete placement, setting or hardening properties.

AGGREGATE: granular material, typically graded by size, such as sand, gravel, rock, recycled concrete etc.

BLEEDING: the autogenous flow of mixing water within or its emergence from freshly placed concrete.

BUG HOLES: voids left in the surface of the concrete due to air pockets.

CEMENT: general term for multiple types and bases but usually referring to Portland Cement.

CONCRETE: composite material that consists essentially of Portland Cement, water, sand, and graded rock aggregate.

CREEP: the deformation of the concrete over time due to sustained load.

CURING: action taken to maintain moisture above 80% rH and temperatures between 50f and 120f to allow for full hydration of the cement in freshly placed concrete.

CURLING: the distortion of a linear or planar member into a curved or warped shape.

DRYING: the reduction of the relative humidity to below 80%.

FINISH: the texture of a surface after consolidating and finishing operations are complete.

HONEYCOMB: the voids left in the concrete due to failure of the mortar to effectively fill the spaces among the coarse aggregate.

HYDRATION: formation of a compound by the combining of water with some other substance.

LAITANCE: a layer of weak material derived from cementitious material and aggregate fines carried to the surface by bleed water.

MOHS SCALE: arbitrary quantitative units ranging from 1 to 10 used to determine the hardness of a substance.

MORTAR: a mixture of cement paste and fine aggregate.

MUD: the common term used for fresh concrete.

RODDING: a common term for tamping or consolidating freshly placed concrete.

SCREED: to strike off concrete laying beyond the desired plane or shape. a board or metal strip dragged across a freshly poured concrete slab to give it its proper level.

SUSTAINABILITY: the quality of being able to continue over a period of time.

BASIC CONCRETE BEHAVIOR

Concrete has three states or phases—plastic, curing and hardened. The plastic state is when the concrete is wet, fluid and workable. The curing state begins once finishing operations are complete. And finally, the hardened state begins once curing stops or design strengths have been met. The hardened state has been traditionally identified as beginning after the first 28 days of curing. Each state of concrete also has recognizable and predictable behaviors. When understood, concrete can be controlled and molded into whatever design element is desired. Concrete has a predicable behavior pattern that produces common problems which, in most cases, can be prevented from occurring in the first place.

Concrete, by design, is a conglomeration of individual materials that, when combined, will form a durable building material that can last for hundreds or thousands of years. Concrete will go through several chemical reactions and stages during its life cycle. Most of these stages happen early in the placement of the material, but some can last for months and even years (provided the proper conditions are present). The most common concrete mix design consists of, Portland Cement, water, graded aggregates of various size, sand, and chemical admixtures. Most concrete mix designs also include secondary cements or fillers, such as fly ash or micro silica.

The chemical reactions in concrete are predictable and linear with identifiable behaviors at each stage. Once the chemical process begins, it is imperative that the concrete progresses through each stage of its reactionary process to achieve the desired design strengths and parameters. The process begins with hydration of the cement and ends with properly controlling both the curing and drying phases within the concrete. Curing can take from 3 to 14 days or more depending on the mix design and water to cement ratio. Curing is a process or chemical reaction that is essential in achieving concrete with low permeability and high durability. Controlled drying results in higher quality and flatter slabs.

Once concrete has completed the curing process, the first two phases are complete; however, in the hardened state, it will still have a predictable cause-and-effect behavior over time. These behaviors in concrete make it susceptible to thermal expansion and contraction, as well as flex and stress from moisture loss during the drying phase and beyond. When heated it will expand, when cooled it will contract. It will cycle moisture—either fluid or vapor—and will flex or bend. The strength of the design and the permeability will affect the nature of this movement. The less permeable the concrete (meaning a smaller restricted capillary matrix), the more durable the design will be. The smaller the capillary matrix, the harder it is for the moisture and moisture vapor to move or cycle through the concrete. This low permeability will extend the life of the structure by slowing the rate of chloride ion intrusion as well as other contaminates that affect the structural steel.

CONCRETE CRACKS

There is a saying in the construction industry that there are only two types of concrete in the world, cracked concrete and concrete that is going to crack. Is it possible to design and place concrete so that there are never any cracks? No. Just accept that the concrete will crack. Once you understand this, you can take what you know about concrete behavior and proactively place the cracks (joints) in the locations that you want them. If you don't, make no mistake—they will still occur and they won't be straight.

The industry has adopted the common practice of placing saw cuts (known as joints) strategically throughout the concrete substrate encouraging concrete to move at predetermined locations with the hope of controlling and reducing cracks overtime. Without these joints, cracks can and will show up, negatively affecting the appearance and integrity of the concrete.

Cracks form in many ways, but there are only two general types, static and dynamic. Static cracks are not part of the design elements and typically form from a singular shock or event. Static cracks typically occur before the curing phase is complete and can be filled or sealed. Dynamic cracks are typically part of the design elements, and actively move on a regular basis. These are also subject to thermal dynamics but are designed for movement due to flex or other stresses in the design of the element or structure. Static and dynamic cracks must be addressed differently as they function differently. You must always honor a dynamic crack and treat it like an expansion joint. They can be subject to thermal dynamic movement but are usually stable after they occur.

The following examples are presented to help identify the different classifications of cracks, the primary causes, and how to properly remediate them. Included are some methods to prevent these issues from occurring.

PLASTIC SHRINKAGE CRACKS

- Plastic shrinkage cracks are static cracks that occur due to a rapid loss of mix water while the concrete is still in its plastic state. This loss can be from wind, heat (both internal and external), low humidity, or a combination of any of the above. These cracks typically form along the longitudinal axis of the pour.

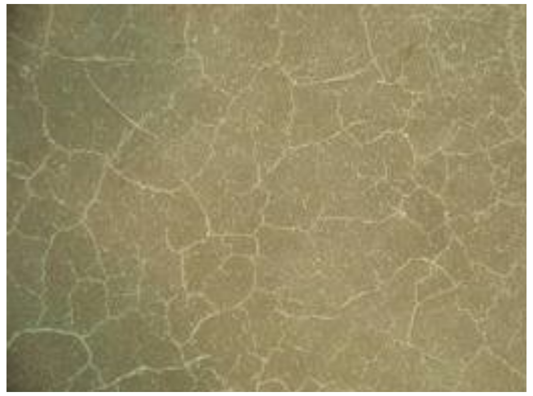
  Plan placements according to weather forecast and implement preventative measures according to ACI-302.1R-15; 13.2.2.1. If not addressed quickly, plastic shrinkage cracks can grow, penetrating through the slab and replacing the function of the joints. Utilizing SINAK AntiVap and Finishing Aid will help prevent these cracks from presenting.

  Repairs can be as simple as tamping the slab before finishing is complete, and prevention can be covering the slab with plastic sheets until ready to finish. Water fog may be used upwind of the pour and should be in the air, not on the surface of the slab. If conditions are difficult, postpone the work or reduce the size and scope of the pour until conditions improve. It is more cost effective to wait than to replace.

DRYING SHRINKAGE CRACKS

- Drying shrinkage cracks are static cracks that occur in a similar fashion to plastic shrinkage. The difference is that drying shrinkage cracks occur after final finishing of the slab and when in the curing or hardened state. During the curing phase, if the concrete dries too fast, it will result in drying shrinkage cracks. Moisture within concrete is necessary to facilitate the curing process. Controlling the moisture or relative humidity within the slab will prevent these unsightly cracks from occurring.

  Drying shrinkage cracks tend to show up within three to five days after the pour. Proper curing with a SINAK Curing Agent, Water Cure Equivalent Type will dramatically reduce the potential for these types of cracks by regulating the rate of moisture loss. Drying shrinkage cracks can progress and run through the slab resulting in potential structural issues. Keep in mind that the concrete is there to protect the reinforcing steel as cracks allow quicker access for corrosive elements. To repair, ensure that there is no scaling or delaminating of the top layer of cream. If it is firm and intact, a low viscosity resin will fill and knit the surface back together.



CRAZING CRACKS

- Crazing cracks are minor static cracks that affect only the surface layer of the concrete and rarely pose a problem structurally. These unsightly cracks are more of a blemish that causes problems for polished or stained concrete flooring. Crazing cracks form under similar conditions to those for plastic shrinkage cracks.

  Retaining moisture at the surface is key to prevention. To prevent crazing cracks from forming, use SINAK Finishing Aid during troweling and begin curing operations immediately after the finishing phase has been completed (the timing of these is typically at the transition from the plastic to curing phases).

  This is important because relative humidity is low, and temperatures are high. The repair of crazing cracks is typically cost prohibitive. If it is necessary due to aesthetic purposes, application of a high strength micro topping is an option.

"BULLSEYE" CRACKS

- Bullseye cracks are static cracks that are the result of two conditions working together, slab curl and load stress. The first condition, slab curl, occurs in both the curing and drying states when the saw cut joints or expansion joints are not cured properly. This results in rapid loss of moisture at the joint causing the slab edges to curl. The second condition happens in the hardened state when the slab is subjected to traffic or load stress. Over time, as there is load transfer from one side to the other (such as a forklift driving across the joints), the cracks form when the slab breaks and falls back into place.

  Bullseye cracks can be prevented by curing the slab properly which will eliminate slab curl. If slab curl is eliminated, when a load moves over the joint, there is nothing curled up from the slab to break off. If curling does occur from a poorly cured slab and it is identified early in the construction process, the void space under the slab can be filled with a cementitious grout or "mud jacked" to prevent load stress from breaking the slab.

  If not caught early, and bullseye cracking does occur, binding the two pieces of slab back together with an appropriate epoxy resin will help to prolong the life of the slab.


INVERTED CRACKS

It is important to know that everything that can happen to the top of a concrete slab can also happen to the underside. The same circumstances that cause topside imperfections can cause underside imperfections. In addition to all the cracks presented so far, there are certain site conditions that will result in cracks later in the slab's life cycle.

When you find cracks that are symmetrical, they are typically the result of a construction defect and must be addressed. Pictured is an example of an inverted crack, which is a dynamic crack because it is taking the place of the sawcut joint. The shallow rebar prevented proper placement of the concrete resulting in a weak plane on the underside of the slab. Even though saw cutting was preformed, the underside "joint" was already in place and resulted in the control joint not serving its purpose. Placing concrete over dry sand beds or without an under slab vapor retarder can result in rapid loss of moisture that will cause cracks to form before saw cutting can begin.

To prevent inverted cracks, place concrete directly on top of the under slab vapor retarder. Always place capillary break or fill under the membrane. If you are faced with inverted cracks, binding the crack with epoxy will act as a suitable repair.

CONCRETE HEAVING

Many times, there will be cracks where one side is drastically higher than the other. These cracks can be static or dynamic, and can be the result of design flaws, compaction failure/settlement, or seismic activity. In addition, drastic changes in temperature can cause shifting or displacement in the slab. Special attention when investigating these types of cracks is critical as they may be a sign of larger structural issues.

There is nothing in the placement of the slabs that will prevent structural defects. In most cases a proper engineering specification can prevent these types of cracks. Bear in mind the human factor, knowing that errors will occur, and plan accordingly. Trust, but verify, everyone is doing their job.

Unfortunately, there will be instances where no amount of prevention can help. Seismic events will occur and can result in cracks to concrete structures.

CONCRETE ISSUES

In addition to cracks, there are several other conditions that can arise from improper placement, finishing, and curing that may result in less-than-optimal durability. Abrasion resistance, permeability, floor flatness, and floor level can all be affected at the time of placement. Proper actions should be taken to prevent unwanted slab conditions from occurring. Sometimes there is no remedy or repair other than replacement.

ABRASION RESISTANCE

Concrete is designed to be strong and durable. The ability of the slab to support a load (psi compressive strength) does not necessarily equate to high abrasion resistance. Remember that the psi testing is done with cylinders that are taken before the material is placed on the ground. This only tests what came down the shoot. What happens to it after it leaves the truck will affect the performance. If you find situations where the concrete is wearing prematurely or inconsistently then you should pay attention.

Low abrasion resistance is primarily caused by too much water at the surface of the concrete during placement. Added water during finishing, finishing too soon or high slump concrete that has water/cement ratios above .50 are the most common errors that result in increased surface water. Additionally, overworking the slab will draw excess fines to the surface and, when mixed with the bleed water, will result in poor surface strength. Excess water is not the only way to reduce abrasion resistance. Excessive air entrainment, deficient curing, early freezing, and carbonation from unvented heaters will exacerbate the wear ability of the concrete. Though this will be an unsightly problem, it is not catastrophic.

Sourcing the right aggregates and proportioning them correctly will improve resistance to wear helping to prevent abrasion. Abrasion resistance issues are typically restricted to the surface of the concrete making it possible to render repairs without replacement. First, remove the compromised surface cream by following ICRI surface profile guidelines. Then resurface the concrete with a high abrasion resistance overlay or topping. These can be either micro toppings or overlay from 1/8" or greater.

DUSTING

Like abrasion resistance, dusting is also the result of weak surface paste or cream layer of concrete. This is usually surface laitance composed of fines and cement particles that were over-watered.

The ACI lists the eight most common reasons as follows:

1. Overly wet mix with poor finishing
2. Not enough cement
3. Contamination with clay dirt or organic materials
4. Use of dry cement as a blotting agent
5. Water applied to the surface during finishing
6. Carbonation due to heater use
7. Inadequate curing or allowing the surface to dry rapidly
8. Freezing of the surface

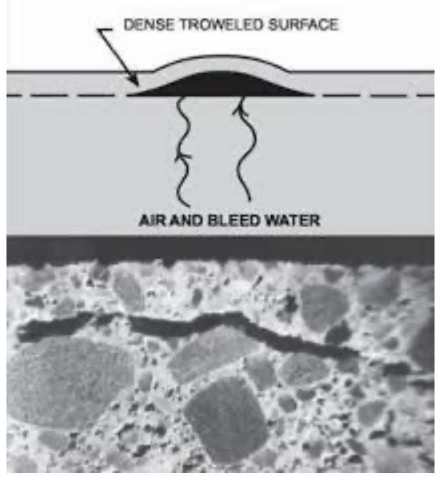
The best prevention methods tend to be following good installation practices, such as not adding water at the site or during troweling operation. Also, protect the surface from rain during placement and ensure proper curing. Depending on the type of concrete being placed, using one of SINAK's curing agents will provide a water-cured result without the hassle of burlap or blankets.

The repair method for dusting is to reconsolidate the paste layer with SINAK HLQ-125 or similar product.

SCALING

Scaling is the loss of surface mortar and/or the mortar surrounding the coarse fine aggregates. In laymen's terms, the top paste layer is peeling off the concrete. ACI-302 lists 16 contributing factors for scaling. They all point to water being the problem, but the mechanism that allows scaling to occur is high permeability.

Due to the underlying cause of permeability, the corrective action is more extensive than in previous solutions. The compromised surface material must first be removed. Then the permeability must be addressed through the application of a deep penetrating sealer/densifier such as SINAK HLQ-125, followed by resurfacing. Additional risks such as micro fractures and potential future flooring failures are also associated with this type of problem. Consult a trusted expert resource such as a SINAK technical representative for more information.



BLISTERS

While blisters are usually associated with installed flooring, they can and do occur in concrete. Blisters may go unnoticed for months. It is not until the flooring is installed that they become a problem. Blisters occur when concrete mix designs are too sticky due to admixtures or too much fine sand. During the finishing process, the cement paste layer sets and seals before the underlying concrete reaches the same state of rigidity. This leads to air entrapment just below the paste layer and allows the formation of water voids that hold the moisture under the sealed surface. ACI 302.1R-15 section 13.7 lists nine contributing factors that lead to blistered concrete. If blisters are not addressed at the time of pour, they can be costly to remedy. These voids, if left in place, will result in popouts or scaling of the surface. In addition, the void space left behind will become a reservoir for moisture to condensate, resulting in flooring failures. These types of conditions are rarely, if ever, covered under any flooring warranty.

Using a shrinkage compensating admixture as well as evaporation retarders and finishing aids will all help to stabilize the set times of the concrete reducing the risk from over working the slab. Scarifying or removing the surface to expose and open the void space and resurfacing is the best method of repair.

POP OUTS

Popouts are exactly what they sound like. They are pieces of concrete that have popped out of the surface due to internal pressure. Popouts are typically caused by expansive aggregates and could be a sign of potential future problems such as Alkali Silica Reaction (ASR) or other contamination. It is very important to confirm the cause of the popout. Do not take the installing contractor's word that it was just mechanical damage from misuse and abuse by other trades on the site. Popouts should result in an investigation to determine what is causing increased internal slab pressure. If it is an expansive aggregate issue, early action must be taken to prevent continued damage.

As with many of the issues already covered, permeability is a major contributing factor to popouts. Lowering the permeability of the concrete will reduce the amount of moisture that can be introduced into the slab and react with the aggregate. For new concrete, proper curing will result in a low permeable concrete and prevent popouts from occurring. For existing concrete, penetrating sealers and densifiers will reduce permeability and mitigate these from continued occurrence. Due to their complex nature, consult with an independent third party involved or your SINAK rep to discuss options.

SPALLS

Spalling of concrete is a much deeper problem than scaling or blistering. Spalls are most commonly the result of corrosion. Remember the concrete is in place to pacify and protect the steel in your structure. According to ICRI and ACI guidelines, there are at least 16 contributing factors to spalling. All but one is directly related to the quality of the concrete. The most common cause of spalling (not directly related to poor concrete placement) is hard wheeled traffic at the joints. All other circumstances should be deemed abnormal until proven otherwise.

The best method of prevention is placing and curing concrete properly. Utilizing a SINAK Curing Agent will ensure lower permeability helping to keep the steel reinforming passive longer.

Repairing spalled concrete is a multi-step process. The process includes proper removal of damaged concrete, passivation of the reinforcing steel, ensuring no contamination, reducing porosity and installation of the proper repair mortar. Follow ICRI concrete repair recommendations for saw cutting and removal of damaged material as well as surface profile for repair conditions.


DISCOLORATION

Discoloration on the surface of the concrete becomes an issue when the surface is the finished floor. Discolorations are not a sign of a structural issue. The good news is that there are several methods that can be used to minimize the potential for discolorations. Admixtures can affect the finished color of concrete. Talk with your admixture supplier and ask about known reactions of the various products available. Separate pours and batches of concrete can be different colors. Improper curing methods like the ones shown above will result in discoloration as well.

Signs to look for that may prove to be problematic are dark areas of the finish that have an arch or swirl pattern to them. This could be an indication that dry cement powder was used as a blotter to facilitate drying the surface during finishing. White spots or patterns may denote the use of additional water as a finishing aid. The use of dry cement or water as finishing aids should be prohibited.

The change in the water to cement ratio will result in permeability problems and/or flooring failures in the future. Instead, use a product such as SINAK Finishing Aid during the finishing phase in order extend finishing time in harsh climates and reduce wear and tear on equipment. Aside from grinding and resurfacing or attempting to color or dye the surface, there is not much that can be done to correct it.

LOW SPOTS OR POOR DRAINAGE

Low spots or puddles are commonly referred to as "bird baths". While it is common for most slabs to have some degree of bird baths, there are other conditions that should be noted and investigated should they present themselves. If large areas of the slab show signs of bird baths, there is absolutely a problem. These issues are generally related to improper elevation setting of forms and screeds and are usually found at pour terminations. The slope will be off ratio for the section in question.

Recently there has been the introduction of admixtures that promote either internal waterproofing or vapor control. Concrete finishers report that the transition from plastic to firm/set and ready for troweling is narrowed due to the use of admixtures. Additionally, the concrete retains flex that prevents the trowel from performing properly. These new challenges are resulting in excessive small depressions in the floor that require fill.

The common carpenter motto of measure twice and cut once should be used when setting forms and terminations to prevent the above conditions. Also eliminating admixtures that are known to accelerate set times on large pours will help prevent low spots. When it comes to repairs, generally filling low spots or grinding high spots are the most common methods recommended and used.

CURLING

Curling is defined by the ACI 301 Field Reference Manual as "The distortion (rising up) of a slab's corners and edges due to differences in moisture content or temperature between the top and the bottom of the slab". (pg 360) This photo demonstrates the degree to which this can happen. Notice the large aggregate that was exposed when the transition was ground down to prevent a trip hazard.

During the design phase ensure a proper concrete mix with a low water to cement ratio is developed to prevent placement issues. In addition, the best prevention is proper curing of the slab and the edges and face of the slab when the forms are pulled. Controlling the rate of moisture loss on all sides of the concrete will result in reduced or eliminated slab curl. Use of a proven water cure equivalent curing agent is highly recommended to reduce the propensity of curling. SINAK has developed best practices when using SINAK Curing Agents to assist with this process.

When curling occurs, grinding down the high portion of the slab is the best repair method. In extreme cases of slab curl, mud jacking or grouting the slab will prevent additional damage from rebound or settling.

FLOORING
ISSUES

According to Benjamin Franklin, "an ounce of prevention is worth a pound of cure." While originally addressing fire prevention, this phrase is also applicable to flooring failures. Most all traditional flooring issues can be prevented from occurring by understanding the proper concrete behaviors already outlined in this guide. It is unfortunate that, on most projects, the concrete contractor and flooring contractors do not know one another, let alone coordinate their work. By the time the flooring contractor arrives on the jobsite, it is too late to prevent these flooring problems. Had they been involved from the beginning, they could have communicated to the concrete contractor what they needed for a successful installation.

It is more important to know and understand the test methods and how to interpret their information than it is to look at flooring failures, because in many cases there is not an actual concrete substrate problem. Knowing where the moisture movement or an alkalinity is originating is important in solving the problem.

In the event there is a flooring issue, it is important to remember that sometimes the flooring contractor does not know or understand the testing requirements of the materials supplier. This misinterpretation of test information will often lead to undesirable situations for the building owner such as substantial change orders for moisture remediation systems that may or may not actually be needed.

Poor testing has led to far too many bad decisions and unnecessary expenses—all in order to get a warranty that may not actually cover future problems. There are three primary field tests that are used to determine if there are problems with fresh concrete. These test methods are pH paper, Anhydrous Calcium Chloride, and rH (Relative Humidity) probes. Typically, a surface pH test and one of the two moisture tests will usually be conducted first to determine if flooring can be installed. Each test provides specific data and correct interpretation is essential for success.

PH
TESTING

The pH test is the least expensive and typically should not be used on new concrete. Concrete by its very nature has a high pH. A high pH is necessary to pacify the steel inside the concrete. When concrete ages, the surface will carbonize, and the pH will drop to around 9 on a scale from 1 to 14. The lower the number the more acid and the higher the number the more alkaline. Once the carbonized surface is removed, the pH will rise because the underlying concrete is exposed. This is normal and does not pose a problem. pH testing is best used to determine flooring problems on existing buildings or flooring problems later in the building's life cycle. To prevent or control pH issues, the use of a SINAK curing agent or a lithium based penetrating sealer will stabilize and reduce the level of carbonization and control the pH.

CALCIUM CHLORIDE
TESTING

Currently the oldest of the test methods, the Calcium Chloride test is still the best in determining if there is a potential permeability problem with the concrete. Permeability, or the measure of potential moisture movement through the concrete matrix, is most accurately determined through this test. This test method measures the amount of liquid water by weight that is suspended in the concrete and its ability to move. The weight of liquid water within the concrete can be accurately measured compared to the gas or vapor in the rH test.

Measuring fluid weight has a direct correlation with void space as it is a volumetric test. Because liquid is not compressible, the water weight can only exist in the void space so the more water weight, the more space and thus the more permeable the concrete. This explains why it is possible to have a Calcium Chloride test below 3 lbs per 1000 sq ft and a rH test above 90%. On the surface this is contradictory which is why understanding each test method and their results are so important.

RELATIVE HUMIDITY
PROBES

The use of relative humidity probes has grown exponentially over the past several years. Relative Humidity probes measure the amount of moisture that is suspended in air. How they do this is based on an understanding of fluid dynamics, in that moisture, whether fluid or gas, will always find equilibrium. Example: when you remove a bucket of water from a pool, there is not a hole left. The water finds a balance. The same is true for moisture vapor. The problem is that the test does not measure the size of the void space inside the concrete it only measures the saturation level of moisture vapor in the air surrounding the probe.

Without knowing the size of the void space or the size of the open capillary matrix within the concrete, there is no way to determine the potential for moisture vapor movement. Remember that rH is only a measure of potential moisture energy that can convert into liquid. This is important to understand because the rH of a void the size of a pin head is the same as the void space in a 5-gallon bucket. Consequently, a reading of 95% rH in a pin head is less of a concern when compared to that of the 5-gallon bucket. If there is no transportation method for the moisture to move, rH becomes irrelevant.

SINAK SOLUTIONS

Many of the problems listed in this guide may be prevented by using more reliable products. Continue reading for SINAK's suggested solutions to common job site challenges.

ELIMINATE MOISTURE FAILURES

SINAK SOLUTIONS

VC-5

SINAK VC-5™ is a ready-to-use, zero-VOC Moisture Vapor Control System that eliminates flooring or roofing failures due to moisture, moisture vapor, hydrostatic pressure, and alkalinity emanating from or through the concrete. VC-5™ is designed for use on all structural and lightweight concrete to receive finished flooring, roofing, or coatings.

NEW CONSTRUCTION

FEATURES & BENEFITS

- Water cure results with same-day slab access
- Exceeds ASTM C-309 & ASTM C-1315
- Eliminates slab curl
- Compatible with all densifiers & polish systems
- Ul® Greenguard Gold Certified

VECT-R

VECT-R™ is a ready-to-use, penetrating, zero-VOC Vapor Emission and Alkalinity Control System that eliminates flooring failures due to moisture, moisture vapor, hydrostatic pressure, and alkalinity emanating from or through existing concrete. VECT-RTM is specifically designed to repair existing concrete that has failed to meet the flooring manufacturer's requirement for adhesive or flooring installation.

EXISTING CONCRETE

FEATURES & BENEFITS

- 20-Year flooring replacement warranty protects from all concrete moisture-related failures
- Flooring can be installed 4 hours after application
- Permanently penetrates deep into the concrete substrate & does ntot need to be reapplied for the life of the concrete
- Adhesives & finished flooring materials are included in the 20-year warranty

NO CURING BLANKETS?
NO PROBLEM.

SINAK SOLUTIONS

LITHIUMCURE 1000

SINAK LithiumCure 1000™ is a zero-VOC Curing Agent, Water Cure Equivalent Type, used to cure freshly-placed exterior concrete. LithiumCure 1000™ creates an internal membrane deep within the concrete substrate, resulting in improved hydration, elimination of slab curl, and improved abrasion resistance. LithiumCure 1000™ is recommended for use on exterior pavements, colored concrete, and potable water applications.

EXTERIOR CONCRETE

FEATURES & BENEFITS

- Water Cure results with Same-Day Slab Access
- Eliminates Slab Curl
- NSF 61 Potable Water Certified
- Exceeds ASTM C-309 & ASTM C-1315
- Compatible with All Traffic Coatings
- Contributes to LEED v4 Credits

LITHIUMCURE 2000

SINAK LithiumCure 2000™ is a zero-VOC Curing Agent, Water Cure Equivalent Type, used to cure freshly placed interior concrete. LithiumCure 2000™ creates an internal membrane deep within the concrete substrate, resulting in improved hydration, elimination of slab curl, and improved abrasion resistance. LithiumCure 2000™ is recommended for use on interior, hard toweled finished concrete.

INTERIOR CONCRETE

FEATURES & BENEFITS

- Water cure results with same-day slab access
- Exceeds ASTM C-309 & ASTM C-1315
- Eliminates Slab Curl
- Compatible with all densifiers & polish systems
- UL® GREENGUARD GOLD CERTIFIED

CONTACT US

- There are a myriad of problems that can occur when utilizing concrete. Understanding the cause and effect that is associated with each step of the process is essential in understanding the prevention. Whether it is in the original design or at the day of pour, standing firm in the specification and understanding the total consequence of "value engineering" is your responsibility. Tests can be useful in gathering specific data, but not having a full understanding of that data can result in unnecessary change orders.

  For additional concrete resources, questions about this guide, or information on SINAK products, contact us at (800) 523-3147 or email Jeff Mosley at jeff@sinak.com.

SPECS AND CERTIFICATIONS

Interested in product specs, certifications, or more about SINAK?
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REFERENCES

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