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# CTIOA REPORT 2011-4-11

## SUBJECT: POOL TILE INSTALLATION

### INTRODUCTION

The purpose of this report is to explore the current options for installing tile on concrete (gunite, shotcrete, cast in place concrete and cinder block) swimming pools, spas and other similar water features as well as discuss the issues the industry experiences as the result of the many types of tiles, installation materials and methods being used in these assemblies.

It is not the intent of this report to explore the concerns of installing tile on substrates such as fiberglass, stainless steel and other substrates at this time, however, we are likely include more information on these types of tile installations in the future.

Pool tile installations can range from simple water lines, steps, infinity edges, all tile spas, all the way to tiling an entire pool. This report will explore all of the above in order to develop a comprehensive list of best practices for installing tile on these types of water features.

Because of the wide variety of materials available in today's market, the authors were asked to explore the available options in a non- proprietary manner out of respect for the CTIOA Inc. Technical Committee and the industries it serves.

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11) Glossary of terms

## EVALUATING THE STRUCTURE

1) Check the overall integrity of the structure. Some of the more typical common warning signs would be in the order of structural cracks, exposed re-bar, out of level or low bond beam.

2) Observe surrounding landscape and hardscape to make sure proper measures have been taken to provide movement provisions between the decking and water feature shells.

3) Observe any water or moisture entering the pool from an outside source through the shell, which may be an indication of hydrostatic pressure.

4) Infinity edge pools- Close inspection of the wall between the pool and catch basin is essential. Due to its free standing nature, these areas may exhibit signs of internal voids and corrosion of structural steel if the concrete, shotcrete, or gunite is not properly shot or cast.

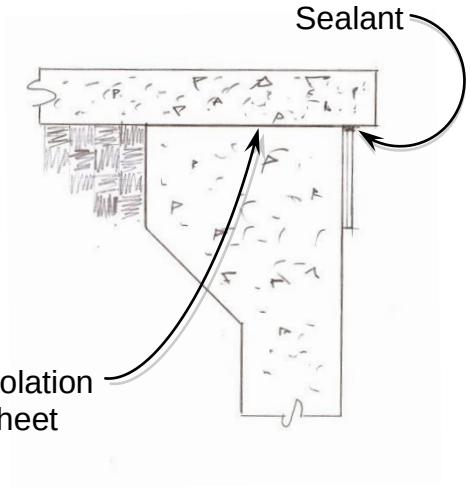
5) Verify that the pool has been engineered and built in accordance with local regulations, according to soils reports, and water table fluctuations have been taken into consideration.

   Note: This is the responsibility of the pool contractor.

## TILE / COPING INTERFACE

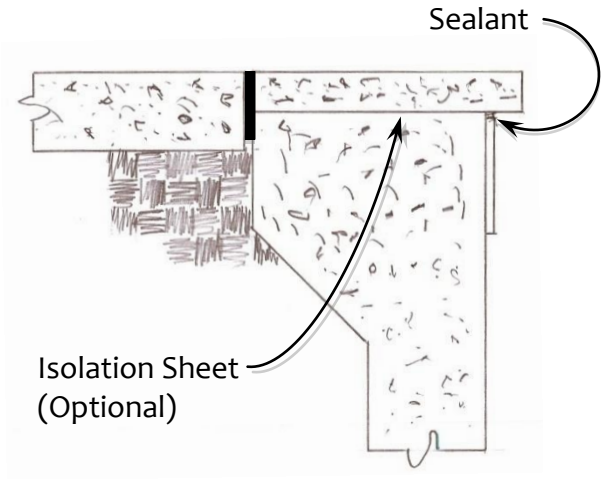
Pool coping comes in a variety shapes, forms, and designs, including the following:

1) Cantilevered concrete decking- A concrete deck around the pool spanning over the bond beam and waterline tile in a manner allowing the deck to "slip" back and forth as needed. This is usually accomplished with a trowelable membrane, #15 felt paper, 6mil. Plastic or equal. A movement joint is then placed between the coping and the top of the pool tile.

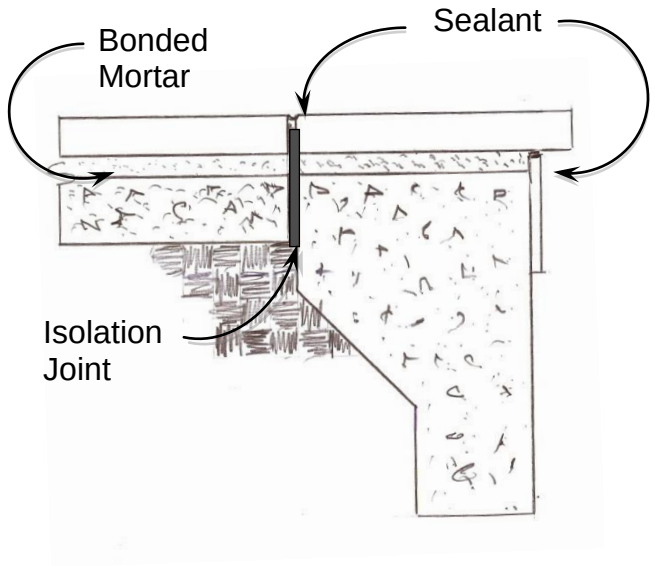



2) Cast in place concrete coping: Concrete coping formed on top of a bond beam, extending over the edge of a pool by 2" to 3" and generally terminates in line with the back of the bond beam. Any concrete sub-base or decking that butts up to the coping and / or pool

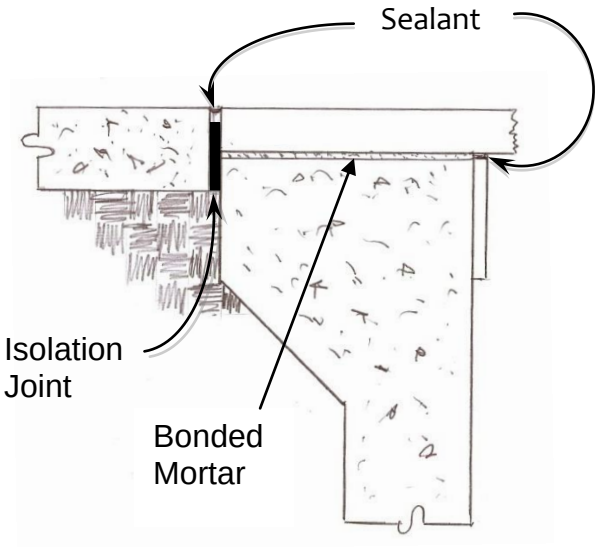
shell must have an expansion provision between the two.




3) Pre-Cast Coping: This coping is generally cast into molds off-site using concrete or pressed clay, allowed to cure and then brought to the site for installation. It's made in straight pieces, end caps, and varying radius's that will accommodate different pool shapes.

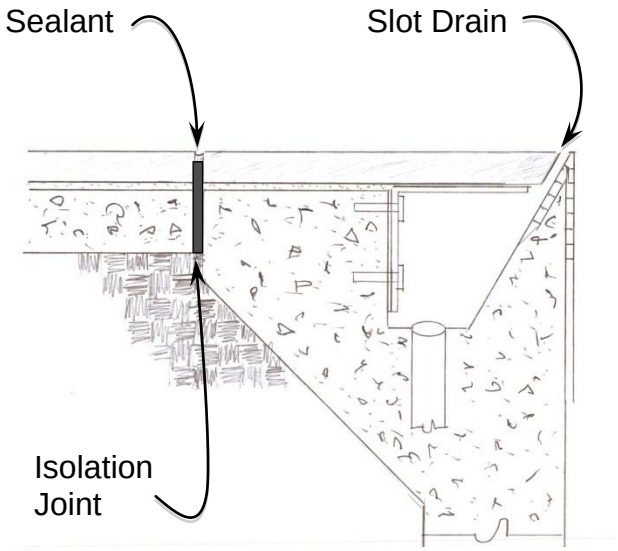



4) Quarried Stone Coping: Stone of various species, sizes, shapes and thickness installed onto the top of the bond beam.




5) Mechanically Fastened Coping: Commonly used in Rim Flow and Slot drain pools, This type of coping is generally attached by fasteners to structural systems spanning over a trough designed for water to flow

into. The coping is flush with the decking and the top of the tile, allowing a slot of ¼" to ½" in width for water flow.




***Coping Placement Overview:***

Note: The interface of coping and tile as they relate to the bond beam of pools and adjoining decking behind them can account for a significant percentage of pool tile failures when installed improperly. These failures are often a result of pressure applied to the pool shell, coping, and / or tile, from pool decking, and adjoining structures.

The following are a few key points to keep in mind when installing coping:

1) Cantilevered decking must be free to slide over the top of pool bond beams without putting pressure on waterline tile. If the bond beam of a pool is set too low for this to occur, it must be raised and bonded mechanically or chemically to the existing bond beam, bringing it up to the same plane as the top of the waterline tile. A movement joint must be placed between the top of the tile and the bottom of the coping.

2) Cast in place coping must be placed over a bond beam that is on the same plane as the top of the waterline tile. It should be either mechanically or chemically bonded to the bond beam unless the intent is to have it float freely on top of the bond beam.

   It's important to have movement provisions between the top of the waterline tile and the bottom of the coping. Equally important is to have the back side of the coping terminate at the back side of the pool structure, placing movement provisions between this area and the any decking that abuts to it.

3) Pre-Cast coping and quarried stone must have a positive bond to the bond beam of the pool. A positive bond can be achieved in two ways:

a) Thin-set installation: Pre float the bond beam by bonding the mortar with cement slurry or 1/8"of modified thin-set. The coping can then be installed over the cured mortar bed using a medium bed thin-set applied

to the mortar bed and the bottom of the coping.

b) Mud set installation: Apply cement slurry or 1/8" modified thin-set to the bond beam, followed by a mortar bed. The coping should then be back buttered with cement slurry or 1/8" modified thin-set, placed into the mortar bed and tapped into place.

**SURFACE PREPARATION**

Preparation and cleaning: Concrete pool shells are rarely smooth, free of contamination and defects, and are generally insufficient for the direct application of waterproofing or tile without proper surface preparation. Proper preparation and cleaning of all surfaces to be tiled is imperative to a successful installation.

For cast in place concrete, all surfaces must be inspected for remnants of form release agents or curing compounds as well as surface defects such as honeycombing and laitance, etc. These conditions can also be present on free-standing walls typically found in vanishing edge pools in which a form was used as a backstop to shoot gunite or shotcrete against.

Concrete pool shells are also subject to surface defects such as dusting, crazing and laitance from improper finishing, as well as outside construction debris and dirt ground into the pool throughout the course of construction.

Once all construction debris, dirt and free standing water have been removed from the pool, the following protocol should be followed:

1) Inspect the structure for any high areas in need of chipping, grinding or bush hammering and lower as needed.

2) Inspect all pipe penetrations, light niches and any other penetrations coming into the shell of the pool where tile is to be installed. Use a light chipping hammer to carefully chip all debris from around pipes and lights, paying particular attention to any cavities in these areas. Typically, large penetrations such as lights and large pipes will have some degree of slump during the application of shotcrete or gunite, leaving voids underneath them. This condition as well as inconsistencies around smaller pipes can lead to leaks if not addressed during this stage of preparation.

3) Clean the entire surface of the pool in order to remove any and all of the aforementioned impurities. Listed below are some of the methods, which will vary depending on the condition of the surface.

   a) Low pressure washing/scrubbing (garden hose with pressure nozzle)

   b) Acid cleaning followed by a neutralizer and rinsing with clean water.

   c) Sand blasting

d) Grinding

e) High pressure water cleaning (1000 psi)

f) High pressure water blasting (5000 to 8000 psi)

Once the pool is prepared, washed and allowed to become "saturated surface dry", it's ready to start filling any large voids in the shell and around all penetrations with hydraulic cement. Caution must be taken to allow enough room around all pipes for the installation of fittings later.

**WATERPROOFING**

Pool waterproofing falls into several categories, all of which can be very effective depending on a variety of conditions the pool may be subjected to, as well as the level at which the pool is expected to perform. While properly waterproofed vessels will far exceed the industry standard for in ground pools, there are conditions in which some systems will be superior for a variety of reasons including the following:

1) Partially or fully above ground pools and fountains. This could include hillside pools that are exposed underneath.
2) Structures that may be subjected to movement. i.e. cold joints, concrete blocks,
3) Pools in close proximity to or particularly above occupied space, garages, or other similar areas

Additionally, extreme conditions may require multiple systems used together.

An example is a pool in which an elastomeric system is specified, but the area in which the pool is built experiences hydro-static pressure, from the negative side, stronger than the elastomeric system would be capable of sustaining. This is a case in which a cementitious waterproofing capable of holding back hydro-static pressure could be applied to the pool shell prior to the application of the mortar bed in which the elastomeric system will be applied.

***Some of the most common systems are as follows:***

a) External or "sandwich" waterproof membranes- One example would be a sheet membrane placed into the excavated area prior to actually shooting the pool. This method is typically used when extreme external or negative hydrostatic pressure is present. This would be used in conjunction with another system inside the pool to keep water from entering the shell.

b) Integral crystallization - An additive mixed into the concrete or mortar that promotes crystalline growth that ultimately blocks the capillaries in the cement.

c) Topically applied crystallization – This uses the same principle as the integral but is

applied to the surface of the concrete shell. The concrete must be saturated and allowed to become saturated surface dry before the cement paste is applied, at which time the crystals are activated and will grow into the concrete as far as moisture is present.

Note: During the process of crystalline growth, residual crystals can accumulate on the surface and act as a bond breaker for subsequent layers waterproofing or other bonding materials. It's imperative to remove all potential contaminants prior to the application of additional material.

d) Dense cementitious film- A prepackaged cement powder that when mixed with water or acrylic, depending on the manufacturers' recommendations, can be applied to the surface of the concrete shell and will cure into a dense film capable of holding back moisture.

e) Elastomeric membrane- Usually latex based, these systems are typically applied over a cured mortar bed and have flexible characteristics. Once applied and cured, tile can be installed directly over them with an approved thin-set.

f) Flexible cementitious - Similar to the elastomeric system but a two-part cement/latex based waterproofing. This system can be applied directly over the shell and floated over by bonding the mortar with an approved thin-set or applied over a cured mortar bed. Tile can then be bonded directly to it with an approved thin-set.

**WATERPROOF APPLICATIONS**

Waterproof applications will vary significantly depending on the type of system being used as well as specific manufacturers' recommendations for a given product. While it's extremely important to follow all of the manufacturers' instructions, the following are some basic guidelines and areas of importance.

1) Cementitious systems- When applying any type of cementitious waterproofing in which it's recommended to wet the substrate, always allow the surface to become saturated surface dry (damp with no puddles, or moisture glistening on the surface) prior to application. Failing to do so will inhibit the product from achieving a proper bond to the substrate.

2) Subsequent bonding lines- In multiple applications, each application is considered a bonding line and should be treated as such in order to achieve positive bonds throughout all applications.

3) Continually observe pool for any signs of moisture coming through the shell from an outside source. In the case of such an occurrence, the source of moisture migration should be sought out and stopped

before continuing any further application of waterproofing.

4) As mentioned under "Surface Preparation" in subsection #2, attention to pipe penetrations and light niches is of upmost importance. Recognized as one of the most likely sources of leaks in a pool shell, all voids around these penetrations should be tightly packed with hydraulic cement.

As an added measure, pipe flanges can be considered where applicable.

***Scratch coat (if applicable) and float coat***

The following materials and suggested applications apply to traditional mortar systems.

Manufacturers of some waterproof systems may require specific mortar systems that are more specifically designed to perform in conjunction with their waterproofing.

In the event that a specific waterproofing system is specified, manufacturers' instructions will supersede these recommendations.

***Materials***

Cement – Portland cement ASTM C150

Sand – Washed Plaster Sand ASTM C144

Lime – ASTM C206 Type S or ASTM C207 Type S

Water- Potable

***Mortar Ratios***

Mortar bed (pool bottom) – 1 part Portland cement, 4 to 5 parts damp sand by volume. When mixed with water the mortar shall have such consistency that will allow greatest compaction during tamping of the mortar bed.

Scratch coat and mortar bed (pool walls and gutter) – 1 part Portland cement, ½ part lime (optional) and 4 parts sand

Note: Mix ratios can vary depending on local materials.

**BONDING MATERIALS APPLICATION**

1) Bonding Materials (not to be used to build up substrates)

2) Portland cement paste

3) ANSI 118.1 Dry Set Portland Cement Mortar minimum 1/8"

4) ANSI 118.4 Modified Latex-Portland Cement Mortar - minimum 1/8"

   Scratch coat and/or subsequent plumb scratch (if necessary for excessive build up) A bonded scratch coat should be used an areas in which excessive build up is necessary, or where the possibility of the float coat "sliding" is imminent.

5) Float coat (walls) Uniform thickness ranging from ½" to ¾".
6) Float coat (floors) shall not exceed 2" in thickness per lift without

approval of the architect or engineer.

## POOL TILE SELECTION

It is a tile's physical properties that determine its suitability for use in pools and water features; not all tile should be installed in submerged applications.

Historically, tile intended for submerged applications was marketed as "pool tile" making the tile selection process fairly straightforward. In the diversified modern tile market, products are less likely to be marketed for specific applications. It is the design professional, specifier, installer and owner's responsibility to solicit tile usage recommendations from the tile manufacturer. It is the tile manufacturer's responsibility to provide these recommendations.

The following are some of the physical tile properties manufacturers generally take into consideration when evaluating a tile's suitability for submerged applications:

- Water Absorption
- Freeze-Thaw Resistance
- Chemical Resistance
- Post-Submersion Bond Strength (mesh-mounting/coating deterioration)
- Thermal Shock Resistance

Only tile that is recommended by the manufacturer, in writing, for use in pools, spas and water features should be installed in these locations.

## INSTALLATION

1) Recognized Installation Methods - ANSI A108.14, 15, & 16
2) Bonding Mortars - ANSI A118.1, 118.4 & 118.3
3) Grouts – ANSI A118.6 Standard Cement grouts (sanded & un-sanded) and A118.7 High Performance Cement Grout (sanded & un-sanded).
4) Movement joints – the CTIOA acknowledges ANSI A108.01.3.7 & A108.02.4.4 – 2005, as well as TCNA EJ-171 for the installation of movement provisions in water features. However, we recognize pools as being unique in that they generally offer two very different sets of circumstances within the confines of the same vessel; above the waterline and below the waterline.

   A) Above the waterline: This would include all areas from the waterline up to the interface of the coping or other dissimilar materials in which independent movement may take place. Also included in this category would be raised bond beams, feature walls and infinity edge spillways, as well as any other area where tile may be subjected to extreme temperature variations, freeze/thaw conditions, or daily wet and dry cycles.

B) Below the waterline: all areas of a pool tile that are continually submerged. This may be anything from the lower portion of a 6" waterline tile, step features, all the way to a fully clad pool spa or fountain. It is the opinion of this committee that while provisions between decks, copings, dissimilar materials and installations subject to independent movement, extreme temperature changes, including freeze thaw cycles require movement provisions, movement provisions are not always viable in continually submerged tile installations.

In summary - It is not the intent of this committee to dissuade the use of, or downplay the necessity of properly placed movement joints. We do however recognize that the common trade practice of minimizing movement joints in continually submerged installations appears to be a viable option in comparison to its above the water counterpart.

Although this is the case with most residential pools, extremely large pools or commercial pools many times contain cold joints or working expansion joints in order to accommodate movement or multi day placement of concrete,

Important to remember is that all expansion, control, construction, cold, and seismic joints in the structure must be honored and continue up through the tilework.

As with any tile installation, the aforementioned standards, ANSI A108.01.3.7, A108.02.4.4 – 2005 and TCNA EJ-171 should be the primary point of reference for movement joint considerations. It is the responsibility of the architect, engineer or builder to specify type of joint and show locations. By default, the burden will fall on the tile contractor to discuss these options with the owner or owner's representative.

5) Working conditions- Ambient temperatures should be maintained between 50°F and 90° F degrees throughout the installation and curing process. Keeping in mind that low humidity during hot conditions can accelerate the curing process of cementitious products, temperature and humidity parameters should be verified with the thinset and grout manufacturer. In the event of climatic fluctuations beyond given parameters, precautionary measures should be taken to protect the installation.
Bonding and coverage of bonding material to the back of the tile is essential in submerged applications. As stated in the TCNA handbook for the installation of ceramic tile, "95% bond to the bonding surface to the tile is mandatory".

***Troweling methods and open times of thinset prior to placing tile.***

1) Trowel sizes will vary depending on the type, size and thickness of the tile being used.

2) While flattening out the ridges of a notched trowel prior to placement of all tiles is good practice in order to achieve 95% coverage to the back of the tiles, it's imperative with glass tile of all sizes, weather opaque, translucent, or transparent.
3) Open times of thinset will vary depending of a variety of conditions, including ambient temperature, humidity, and wind conditions to name a few. Additionally, manufacturer's instructions referring to open times will vary. It's always best to proceed cautiously and check for "skimming over" of thinset throughout the course of the installation process and adjust perceived open time accordingly.

**Mounted assemblies**

a) Paper faced
b) Clear film face mounted
c) Back mounted with mesh.
   Differentiate between water soluble and water stable glue for mounting the tile to the mesh. While we don't recommend water soluble glue, performance of both is the burden of the tile manufacturer and should be stated in writing.
d) Perforated paper back mounted tile. Not recommended by TCNA
e) Edge mounted tile

Commentary about the benefits and drawback of each of the mounted assemblies.

**Paper face mounted assemblies:**

Benefits:

a) 100% access to the bonding surface of the tile.

b) Easy to adjust individual tiles once the paper is removed, assuming the paper is removed while the thinset is still pliable.

Drawbacks:

Requires an installer with a higher level of experience than other mounted assemblies.

**Clear film face mounted assemblies:**

Benefits:

100% access to the bonding surface of the tile.

Good visibility of the installation through the clear film.

Drawbacks:

a) Inability to remove film while the thinset is pliable for fear of breaking bond to the tile. Adjustments can be made by cutting through the film; however, the installer is somewhat limited to the amount of adjustments that can be made as compared to paper face systems.
b) Inability to remove thinset that has pushed up through the joints to the back side of the film until the film is removed.

**Back mounted assemblies:**

Benefits:

Ease of installation as compared to face mounted assemblies, including the speed at which sheets can be installed as well as the immediate access to the open joints for the removal of excess thinset. Sheets can also be adjusted to some degree without having to cut through mounting material.

Drawbacks:

a) Limited access to the bonding surface of the tile due to mesh and the glue holding the mesh to the tile.
b) Limitations to the maneuverability of sheets while negotiating the curvatures in pool bottoms and other transition areas.

**Edge mounted assemblies:**

Benefits:

Typically, good access to the bonding surface of the tile.

Ease of installation on flat, non-challenging surfaces.

Drawbacks:

a) Limited ability to adjust sheets or negotiate curvatures and transition areas in pool bottoms.
b) Edge mount material can sometimes encroach the surface of the tile to some degree and ultimately jeopardize the grout by leaving inconsistencies in its thickness.

**CURE TIME AND START UP CONSIDERATIONS**

1) Proper cure time minimum 21 days after grouting & caulking, prior to fill.
2) Keeping the pool covered during the curing process
3) Flow rate of fill or emptying water 1" per hour.
4) Tests fill water prior to filling pool.

**WATER SANITATION SYSTEMS**

***I. Introduction***

As most tile surfaces have cementitious grout or polymer modified cementitious grout products in them, a proper water chemistry regimen is essential for the long-term durability of these products. This begins prior to filling the pool or spa, with tap water testing, and then continues with the long-term chemical

maintenance of the pool, spa, or water feature.

Prior to filling water features, the tap or fill water must be tested. The fill water should be checked for pH, total alkalinity, and calcium hardness. Tap water should also be checked for dissolved metals. This is especially true for well water.

***II. Summary***

Fill water with low calcium hardness, low pH, and/or low carbonate alkalinity coming in contact with cementitious grouts are capable of deteriorating the cementitious compounds of the grout. If the water is aggressive enough to leach calcium from the grout's matrix or to break down cement compounds, then the problem must be identified and addressed after the pool is filled. The water must be brought up to the ANSI/APSP standards for residential or commercial pools as quickly as possible to avoid short-term and long-term durability issues.

The Association of Pool and Spa Professionals (APSP) ideal water chemistry parameters for residential pools:

It is recommended that the pool water chemistry be maintained using the Langlier Saturation Index (LSI).

The APSP ideal LSI range is 0.0 to +0.5.

The National Plasterers Council's (NPC) water chemistry parameters are similar to the Association of Pool and Spa Professionals (APSP) standards, but with some differences:

| TABLE 2. NPC | |
|---|---|
| **PH** | **7.2 – 7.6** |
| **Carbonate Alkalinity** | 80 – 120 ppm |
| **Calcium Hardness** | 200 – 400 ppm |
| **Stabilizer or Cyanuric Acid** | 30 – 50 ppm |
| **Free Chlorine** | 1 – 3 ppm |
| **TDS** | 300 – 1800 ppm |
| **Salt** | 2500 – 3500ppm (Salt Chlorination Systems Only) |

| TABLE 1. ANSI/APSP | |
|---|---|
| **PH** | **7.4 – 7.6** |
| **Total Alkalinity** | 80 – 120 ppm |
| **Calcium Hardness** | 200 – 400 ppm |
| **Stabilizer (CYA)** | 30 – 50 ppm |
| **Free Chlorine** | 2.0 – 4.0 ppm |
| **TDS** | 1500 ppm greater than TDS at pool or spa start-up. |

The NPC recommends a Langlier Saturation Index (LSI) of 0.0 to +0.3 for maintenance of pool water. The reason carbonate alkalinity is used instead of total alkalinity or tested alkalinity is due to the LSI using carbonate alkalinity only in its mathematical calculations. Carbonate alkalinity is calculated by subtracting a percentage of the pools' cyanuric acid content from the tested alkalinity, thus giving you a corrected or carbonate alkalinity. (See Attached Table K from the Taylor Technologies Test Kit Booklet)

Two key factors found in the NPC Daily Water Chemistry and Maintenance sheet are no negative indices in the LSI and the use of carbonate alkalinity. If a LSI calculation produces a negative number, then the water is under saturated and thus capable of producing a deleterious effect on cementitious materials and other materials used to construct pools.

The NPC Swimming Pool Start-up Procedures sheet recommends that no salt (NaCL) be added to the pool or spa water for at least 28 days. The logic behind this waiting period is to allow the pools' cementitious materials to hydrate or mature without the presence of sodium chloride affecting the new hydration products that are rapidly forming in this early stage of curing.

Tile grout, being cementitious, is also developing strength during this initial 28-day period so the same recommendations for introducing salt should also be followed as a prudent measure.

If the presence of metals or a high mineral content is discovered during the initial tap or fill water testing, then the use of a sequestering agent is recommended. Follow sequestering agent manufacturers' directions as to the proper initial dosage and then the maintenance dosage to prevent staining and mineral precipitation issues.

### *III. Conclusion*

Most pool surfacing materials will be affected in both the short and long term by the water if it is not maintained to the appropriate standards. From dissolution of the grout by aggressive waters to staining and mineral precipitation, properly balanced water is an essential requirement for the cosmetic and long-term durability of all tiled water features. If the water is not kept balanced, long-term damages may also occur to the bonding materials floating materials, waterproofing and even the tile itself.

## GLOSSARY OF TERMS

### Terminology

**Acid Washing -** 1. The cleansing of the plaster surface, through controlled dissolution of the material on a cementitious coating's surface to remove efflorescence, dirt or other unwanted stains. 2. The process of etching of a cementitious coating's surface in order to expose the aggregated or sand to create the exposed aggregate finish. 3. A low strength (diluted) acidic solution used for removing certain cementitious surface stains, dirt, precipitants, or marks, whereby the stain is removed while little, if any, of the cementitious surface has been compromised.

**Admixture -** Any material, other than the cement, aggregate, sand, and/or water, that is added to the mix design, whether as a pre-blend or as an individual constituent added at the jobsite.

**Aggregate -** 1. The inert granular portion of a mix design that is typically refined, sized, graded, and/or apportioned to maximize a cementitious coating's physical and aesthetic characteristics. 2. The sand, rock, or stone portion of the mix design.

**Balanced Water Chemistry –** 1. The National Plasterers Council considers "balanced" water chemistry to be swimming pool water kept in such a manner so as to maintain a chemical condition of a water that is within an ideal range that is: a) within the approved ANSI/APSP ideal levels [see ANSI/APSP-1 Standard. Appendix A] and, b) constantly carrying a sufficient buffer so as to minimize the water's tendency to erode, etch, or otherwise deteriorate the cementitious coating. 2 The process of ensuring that a water's pH, carbonate alkalinity, total alkalinity,

hardness, total dissolved solids, and chlorine content, is being monitored and maintained to be constantly within an ideal range (or "balance").

**Bond (Adhesion) –** 1. The ability of a hardened cementitious coat to hold together with the substrate or to a previous cementitious coat by molecular forces, interlocking action, or both.

**Bond (Chemical) –** The ability to hold together, by chemical process, whether by adhesive or cohesive bond.

**Bond (Cohesion) –** 1. The ability of a fresh plaster mixture to hold together during application and for the mixture to remain inter-mixed during the pumping, placing and finishing processes.

**Bond (Mechanical) –** The ability of a plaster coat to key into, embed with, or otherwise lock together with a plaster under-coat or a substrate.

**Bond Failure –** 1. The failure of the cementitious coating to hold together. 2. The failure of the cementitious coating to remain adhered to the underlying substrate or to another coat.

**Calcium Nodule –** A slang term used in the swimming pool plastering trade referring to a calcium carbonate formation on the surface of a finish coat resulting from the percolation of water that is capable of leaching cement compounds from voids, bond failures, cracks, or a weak sub-boundary layer in the cementitious coating, which is then precipitated onto the surface.

**Cement (Hydraulic) –** cement that hardens and sets by chemical interaction with water and is capable of doing so underwater, for example, Portland cement and ground granulated blast-furnace slag are hydraulic cements.

**Cement (Plastic) –** (NOT RECOMMENDED FOR SWIMMING POOL FINISHES) – A cement manufactured expressly for the stucco plastering industry. A blended cement consisting of cement, lime, and sometimes pozzolans, fillers or additives that give plasticity, or workability, and crack resistance to cement and the plaster.

**Cement (Polymer-Modified) –** A hydraulic cement blended with a monomer or polymer; polymerized in place with a monomer is used.

**Cement (Portland) –** hydraulic cement that is made by fusing certain earth materials through pyro-processing to form hydraulic crystalline compounds, mostly calcium silicates and aluminum silicates. These compounds are pulverized to a fine powder and a small amount of calcium sulfate is added to control the set.

**Compaction –** See Consolidation

**Consolidation –** The process of inducing a closer arrangement of the solid particles in freshly mixed concrete or mortar, during placement by the reduction of voids; usually by vibration, centrifugation, rodding, tamping, or some combination of these actions;

also applicable to similar manipulation of other cementitious mixtures, soils, aggregates, or the like.

**Craze Cracking –** A slang term used within the industry referring to small random cracks. See *Check Cracking.*

**Curing (Shell Structure) –** The act or process by which the gunite, shotcrete, or concrete, continues hydration. Curing is typically done by wetting the shell frequently to ensure that the structure of the swimming pool achieves good strength. Wetting the shell frequently also ensures that the absorption capacity of the shell is lowered to a point at which prevents the cementitious surface coating from losing abnormal amounts of mix water during the placement and finish applications.

**Delamination –** 1. The separation within a material or composition. 2. The separation of the upper surface of the surface coating known also as spalling, a blistering, and/or flaking. 3. The separation between two coats of cementitious material known also as a de-bond or a bond failure.

**Efflorescence –** Soluble salts, predominantly calcium hydroxides, which migrate in presence of moisture, from within a cementitious product to the surface of the cementitious product, followed by the precipitation and carbonation of the soluble salts onto the surface.

**Freeze/Thaw Cycle –** Seasonal weather and temperature changes that can create expansion and shrinkage within a material, which in turn causes stress within the material and can lead to tensile cracking, de-bonding, and delamination.

**Gunite –** See Shotcrete

**Hairline Cracking –** A term used to designate any fine or small crack, whether a structural movement crack, or a check crack, that have widths so small as to be barely perceptible.

**Hydration –** The Chemical reaction between hydraulic cement and water forming new compounds most of which have strength-producing properties.

**Key –** To create a mechanical bond between a plaster coat and another surface by roughening, scratching, scoring, etching, or otherwise creating a surface that the plaster can interlock into.

**Leakers –** A slang term used in the swimming pool plastering trade. See *Weepers.*

**Over-Temper –** To add water to a cementitious material in excess, creating a surface coating that is weak or inferior, typically resulting in a weak surface exhibiting laitance.

**Precipitate –** 1. The solid material which is formed out of solution by chemical or physical reaction. 2. In a swimming pool, it is the minerals and/or metals that come out of solution and settle onto the coating's surface that can adhere, resulting in unsightly stains and roughness.

**Rebound –** 1. The portion of material that is deflected and does not adhere

to the shell during the application of shotcrete. 2. Any portion of material during shotcrete that is considered "dead" or no longer useable and should be removed from the shell.

**Shell –** 1. The structure of the swimming pool that is formed by using gunite, shotcrete, or concrete, which is either poured, sprayed, or packed into a reinforcement network. 2. The substrate onto which the cementitious coating is applied.

**Shotcrete –** A wet mixture of cement and sand that is mixed with water at the nozzle and sprayed onto a contoured surface, having a reinforcement network in place, which when hardened forms the shell of the swimming pool.

**Shotcrete (Dry) –** A dry mixture of cement and sand that is mixed with water at the nozzle and sprayed onto a contoured surface, having a reinforcement network in place, which when hardened forms the shell of the swimming pool.

**Shrinkage Cracking –** The cracking of the cementitious coating due to loss of water and consolidation of materials during set. See also *Check Cracking.*

**SSD** - For excessively dry porous concrete, keep the concrete substrate continuously moist for at least 24 hours before work begins. Remove all excess water and standing water, allowing the surface to become almost dry to provide a saturated surface-dry (SSD) condition before installing the leveling coat or setting mortar.

**Structural Movement Cracking –** The cracking of a cementitious coating due to the structural movement of the swimming pool structure or substrate.

**Watertight –** The National Plasterers Council denotes a cementitious surface as being "watertight" when it does not leak water, however, it is known that cementitious coatings are considered semi-permeable membranes and as such a small amount of water does permeate through the coating, which allowing moisture to reach as far as several feet beyond the shell of the swimming pool.

**Weepers –** A slang term used in the swimming pool plastering trade that denotes any moisture or groundwater that can migrate through the shell of a swimming pool from the underside.

**RESOURCES**

**National Plasterers Council -** Technical Manual Sixth Edition

**MAPEI** -Surface Preparation Requirements /Tile & Stone Installation Systems