

# Flaking, Spalling and Delaminations

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When cement, sand, and water are mixed to form pool plaster, about twice as much water is added as is really needed to hydrate all of the cement. This is done because if the mixture is too dry and thick, it is almost impossible to place and trowel to a smooth finish.

What happens to the excess water? As the solids (sand and hydrated, crystallized cement grains) settle, the excess water rises to the surface. This process is called bleeding, and the rising water is referred to as bleed water. Bleed water then evaporates from the surface.

Swimming pool plaster is commonly troweled in three to five separate passes of the early passes placing the material where it needs to go and consolidating it, and final passes creating the smooth, final surface. One of the arts or skills of the plastering trade is properly timing the troweling passes. If troweling is performed when bleed water is present, forcing bleed back into the plaster paste causes excessively high water:cement ratios in the surface finish, weakening it. Finishers learn to time the troweling passes so that bleed water is evaporated, and the surface workable.

The opposite problem of forcing too much water into the hydrating surface is allowing the surface to dry too fast. If the surface becomes too dry, with a dry crust on the surface but a wet paste underneath, a weakened zone can be formed just subsurface. This can happen when plastering on dry, hot days, during low humidity, in wind, etc. It can also include too much drying between trowel passes, hard troweling, and overworking the finish.



If this happens, the top of the finished plaster will look fine, even for awhile after the pool is filled. However, after time this weakness is manifest by a 16<sup>th</sup> to an 8<sup>th</sup> inch layer of the surface flaking off, generally in small areas or spots. Often, these weak areas do not flake off until the pool is drained of its water and the plaster dries out.

You can see the round indented area with the loss of plaster. This could be described as a moon like crater look, or a shallow and sunken pit look. Note that the newly exposed surface (where the flaking occurred) is extremely rough and coarse, while the older existing surface surrounding the missing plaster area is much smoother.

The general cement/concrete industry has documented this loss of a thin surface layer as a surface defect caused by improper application and troweling. It is referred to by many names, including surface flaking, buckles, blistering, scaling, or delamination. It is not referred to as spalling, since spalling is generally reserved by the cement/concrete industry to describe deeper delamination. But in the pool plastering industry, the term "spalling" has become a commonly used term to describe this shallow surface loss. (We in the pool industry use the terms "delamination" or "bond failure" for deeper bond separation between new and old plaster or between plaster and the substrate, and we use the term "scaling" to describe calcium carbonate depositing from pool water to plaster surface.)

Since the vast majority of pool plaster does not spall, blister, or flake off, we can see that most plasterers properly apply, cure, trowel, and finish the pools they plaster. Spalling is relatively rare, and when it does occur it is most commonly found on a step radius, on shallow end floors, and around the main drain of these being places where finishing can be an additional challenge for a number of reasons. The step radiuses are occasionally over-worked to insure smoothness and straightness, and the floors sometimes



get too much troweling due to being walked on by the pool finishers while troweling. Walls are rarely over-troweled.

One thing that does not play a role in plaster spalling (or peeling) is water chemistry. Aggressive water is not required to form spalls. In fact, as we have mentioned, the inherent weakness leading to spalling is created *before the pool is ever filled with water*.

In disagreeing with the above statement, the National Pool Plaster Council (NPC) has actually claimed in their 2002 & 2005 Technical Manuals that blisters and spalls can be caused by aggressive pool water chemistry. No documentation is provided by the NPC. But note:



- o If aggressive water really was a factor in causing spalling or flaking to occur, then rain water (especially acid rain) would be causing this problem to occur consistently in all cement and concrete surfaces. Rain water has zero alkalinity and hardness, with a pH normally below 7.0. Instead, we only occasionally see this problem on small areas of concrete slabs, where nearby the concrete is relatively smooth with no visible defects. This would confirm that something other than aggressive water caused this problem since it rains everywhere.
- o If aggressive water caused spalling in swimming pools, we would also see aggressive etching of the exposed aggregate in the spalled pit. We don't.
- o And if aggressive water could cause spalling in pools, we would also see spalls on the top step of pools where a trichlor feeder has sat. Instead, in that situation we see acid-etched rings, not spalls.
- o Also acid-started and acid-washed pools would be preferentially prone to spalling o but they are not.



In taking the position that aggressive water causes spalling in swimming pools, the NPC apparently wants to convince the pool industry that aggressive water somehow attacks and penetrates plaster - creating a round or oblong rim, and then dissolves a layer of plaster under the surface which undermines the plaster in this area and then pops it off, creating something that looks like a sunken pit or peeled area. And then, that this aggressive water somehow does not attack the plaster surrounding the popped off area, leaving it smooth and unaffected, and also the top surface of the plaster flake that pops off is still smooth and unaffected. Don't try and make sense of this concept, it doesn't make sense to us either, and it is wrong. Aggressive water does not have a brain in which to plan out a

specialized attack upon pool plaster and cause defects only in isolated or localized areas.

Of course there is no documented research substantiating this claim in the NPC Tech Manual. In fact, just a few years ago, the NPC (1998 Tech Manual) admitted that there was no documentation for their position that aggressive water can cause spalling in swimming pools.

Lastly, the NPC Technical Manual also claims that just draining a pool of its water and not keeping the plaster moist can cause the plaster surface to spall or peel. This is also not supported by any scientific documentation or by empirical evidence. The fact of the matter is that most pools which are drained and left dry do not spall, and the ones that occasionally do spall obviously had the initial construction defect to begin with. And the drying effect occurs over the entire pool surface and we would see spalls on the walls consistently. But as stated before, spalling usually occurs only on steps and shallow end floors.

All of this is unfortunate for pool owners and pool service companies who are now being unfairly blamed for causing this plaster defect.