Ten Steps to Quality Pool Plaster

onBalance – Que Hales, Doug Latta and Kim Skinner

Over the last 15 years, onBalance has been scientifically studying the relationships between swimming pool plaster surfaces and swimming pool water chemistry. Our experience in the fields of water chemistry, plastering, contracting, and lab analysis has enabled us to further the understanding of many issues experienced in pools and spas.

Our field and lab research, coupled with consulting and analysis services from several of the best cement failure-analysis labs in the country, has led to newer and better explanations for the causes and mechanisms of many plaster failures, including etching, scaling, nodules, spotting, staining, and general surface deteriorations. Together with the professional labs, we have been able to demonstrate that known concrete/cement science applies to pool plaster, and we have shared our results in Pool & Spa News, as well as at trade shows and on our website (poolhelp.com).

As a result of the work we have done, we are occasionally asked if we have any suggestions to help avoid plaster problems, and the answer is yes ï although our advice isnôt really anything people couldnôt find already in authoritative concrete/cement industry publications and references. Here is what we would offer as a sort of ñTen-point checklistò of issues leading to either good or bad pool plaster.

First, the best cement/aggregate ratio is about 1 part cement to 1.5 ï 1.75 parts aggregate (marble sand). This produces a higher quality pool plaster product than either richer (more cement) or leaner (more sand) mixes. Plaster that is too rich tends to shrink and crack, and plaster that is too lean is unworkable and isnôt durable. The cement and aggregate should also be selected with care ï it needs to be of good quality, consistent, and of an appropriate grade for use in pool plaster. (This also applies to any admixtures.)

Second, a water/cement ratio of .50 or less is best when mixing plaster. The American Concrete Institute (ACI) and the Portland Cement Association (PCA) have both established that lower water/cement ratios (less than .50) provide for better quality cement which can resist occasional exposure to mild acids. Lower water/cement ratios increase density and reduce permeability, porosity, shrinkage (craze cracking), and movement of water within the cement product. Higher water/cement ratios result in a finished product without adequate protection or long-term durability against the natural effects of water and the environment.

Third, plaster should contain as little calcium chloride set-accelerant as possible, and never more than 2% to the amount of white cement. (Colored plaster, of course, should not contain any calcium chloride.) It has been documented by the PCA and other cement laboratories that using more than this amount increases discoloration, spotting, and shrinkage of cement. Alternatives to calcium chloride, which do not have these downside effects, are now available.

Fourth, a plaster mix should be mixed thoroughly, but also not too long. It is recommended that if the plaster has been mixed for more than 90 minutes, the plaster mix should be discarded.

Fifth, water should not be added to plaster surfaces while troweling because of the strong risk potential. It has been documented by the ACI and PCA that doing so (ñskewing the surface water-to-cement ratioò) increases porosity, shrinkage, spotting, and variable discoloration. Small amounts of water for trowel lubrication doesnôt necessarily seem to have a significant adverse effect on the plaster surface ï most visible problems require a combination of water finishing, chloride abuse, and other improper practices, and take time to become exposed. But it is very important not to ñworkò or force additional water into the plaster surface while troweling. This particular practice can weaken the surface and show deterioration and discoloration much sooner than usual. Colored plaster is even more susceptible to discolorations from water additions than white plaster.

Sixth, well-timed hard troweling can help produce a good dense plaster finish. However, if the plaster surface has overly hardened before a smooth surface is obtained, then late hard troweling to compensate can cause discoloration and spotting, especially when calcium chloride is also used. This also has been documented by the PCA.

Seventh, plastering in extreme weather conditions can lead to durability problems. The ACI and PCA both mention that placing cement-based products on days or in conditions that are either too cold or too hot adversely affects the quality and durability. However, these problems can be avoided by ñtentingò the pool, thus protecting the plaster surface (and the

plastering finishers!) from the extreme temperatures. For example, tenting a pool in extreme high temperatures, and perhaps even directing air from an evaporative cooler under the tent, can help the plaster to retain its moisture and thereby properly cure and harden.

Eighth, once the pool has been plastered and is finished, the filling of the pool with water should not be started too early. Conditions vary, but as a general rule the water should not be turned on for at least 6 hours after finish troweling. This allows the plaster to properly harden before being submerged in water. Even balanced tap water can dissolve certain plaster components from an insufficiently hardened plaster surface, creating increased porosity and early deterioration. onBalance conducted a research study that documented this fact.

Ninth, aggressive fill water can cause deterioration of new plaster surfaces, although this deterioration is uniform ï other new plaster surface discolorations such as drips, splotches, spotting, trowel marks, hand and footmarks, etc. are caused by finishing errors. Surfaces can be further damaged by using aggressive (acid) start-up techniques, which can increase the amount of uniform surface loss. Steps should be taken to ensure that the fill water is appropriate for filling a new plaster pool. Baking soda startups, for example, will both neutralize aggressive fill water and also promote a superior plaster surface.

Tenth, once a pool is filled, balance the water and keep it that way. Although this does not ñcreateò long lasting, durable plaster as the above practices do, balanced water chemistry helps preserve that surface. Long experience has shown that aggressive water uniformly etches plaster, and over-saturated water scales it. The Saturation Index is a good guide ï water should have a saturation index value in the range of ï 0.3 to +0.5. This range does not actively promote either scaling or etching.

Plaster is a good and relatively inexpensive surface that many pool owners desire. Although pozzolans, blended cements, and other advances in the plastering industry can provide even better results, they do not negate the need for proper workmanship, and the last century has shown that standard plaster can last about 20 years with reasonably good maintenance. It is not inherently weak, and unable to stand up to the ñreal worldò pool environment, including the vagaries of chemistry and maintenance.

Now, in the real world we all realize that some variables will be outside the control of even the most professional tradesman. Weather happens, materials that are assumed constant may vary, good-intentioned but unknowledgeable outsiders intervene, etc. We also understand that pool plaster is a hand-crafted product, and nothing in nature ï especially where humans are involved ï is perfect. However, following the above guidelines will certainly help provide for a quality, long lasting, and durable plaster finish.

A plaster finish can also be made poorly. If only one minor abuse of the above guidelines is performed, then it probably wonôt manifest itself with any visible adverse effect. However, if more than one of the above mentioned practices is significantly abused, then a far quicker deterioration can take place even in balanced water.

During the early stages of the plasterôs age, many problems that have commonly been attributed to improper water chemistry may actually be due to one or more of the above workmanship issues.

As a result of our investigations, when plaster begins to show signs of discoloration or deterioration within a few months, and the water balance has been maintained in a reasonably balanced range, we suggest that those involved should investigate whether the above guidelines for providing and making quality and durable plaster were followed. Todayôs technology provides the ability to analyze plaster for most of the above-mentioned issues, such as water/cement ratios, cement/aggregate ratios, calcium chloride contents, whether the surface is more porous than the interior matrix due to water additions, and whether the plaster has been etched by aggressive water or has simply deteriorated due to being of poor quality.

Adhering to good plastering practices and standards, and then following accepted water balance practices will eliminate most all pool plaster problems, pool owners will be happy, and our industry will prosper.

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