Improper Plastering Practices More Harmful Than Aggressive Water

onBalance

How aggressive does water need to be and how long does it take to visibly etch well-made plaster? And if plaster is not well-made, what can even balanced pool water do in terms of early deterioration and discoloration?

The implications of the above questions are at the heart of a recent onBalance study which was funded by a $6,000 donation from the San Diego Chapter of IPSSA. Interestingly, the results of the study showed that a few improper plastering practices were harder on pool plaster than significantly aggressive water.

"Good" Plaster, "Bad" Water ï The first part of the study was designed to determine the amount of calcium that can be dissolved or etched away from well-made pool plaster by aggressive water. Several plaster coupons were made with a proper (low) water to cement ratio, with no calcium chloride (an accelerator), and allowed to cure and harden for 24 hours before being individually submerged in aggressive water for six months. The beginning calcium level of the water they were placed in was 80 ppm and the water was maintained continually with a Saturation Index (SI) ranging from -0.6 to -1.1. After six months, the measurement of the calcium in the water tanks showed an average increase of 50 ppm. (Note: An increase in the amount of calcium in the water indicates a loss of calcium from the plaster surface). No discoloration of these coupons was visible, the coupons remained very white, smooth, and there was no visible shrinkage or craze cracking.

"Bad" Plaster, "Good" Water ï In the next part of the study we investigated how much calcium can deteriorate, or is removed from poorly made plaster that was subjected some improper plastering practices, while being maintained in ***balanced water.*** The beginning calcium hardness level was 180 ppm and maintained in a continual SI range of +0.2 to +0.5. These poor plaster coupons were made with a high water to cement ratio, a high amount of calcium chloride, and were placed in water only one hour after final troweling, representing three common improper plastering practices. Only two days later, the calcium level of the water in the tanks was tested and showed an average increase of 160 ppm! Since the plaster surface area of the coupons to gallons of water was similar to that of an actual pool, we can calculate that this amount of calcium loss from a plaster surface is equal to about 26 pounds of calcium carbonate from a 20,000 gallon pool. A gray discoloration and minor craze cracking of the coupons was also observed, which confirmed the already known effects of using excessive amounts of calcium chloride and a high water to cement ratio.

As can be seen in this study comparison, three times more calcium was quickly lost from the plaster surface due to the improper plastering methods than from significantly aggressive water attacking well-made plaster for six months. A loss of calcium from pool plaster results in a surface that is more porous and weaker. This reduces plasterôs ability to hold up well in a water environment, and makes it more susceptible to staining or discoloration. A loss of calcium from the immediate surface, whether it is from the calcium chloride added to the mix, or directly from the hydration processes itself, may not affect compression strength, but it is certainly detrimental. This loss of calcium (including the chloride) increases porosity which directly affects the aesthetic durability of a pool plaster surface.

There are data from other sources that support the results of our study. The American Concrete Institute (ACI) and the Portland Cement Association (PCA) have documented the negative and detrimental effects from using high water-to-cement ratios, high calcium chloride contents, and ponding (submerging in water) too soon.

Also, results from the NPIRC at Cal Poly have shown some similarities to our results. For example, in their Phase 1 protocol, the plaster sections that were submerged in water immediately after final troweling looked visibly worse in comparison to plaster sections that had six hours of drying time before being submerged in water. In Phase 2, many of the test pools were reported to have had either visible deterioration or discoloration in just six weeks time even though they were in balanced (non-aggressive) water. Pool 4, which had a balanced water startup and was maintained in balance for all eight months, was reported to be the second or third worsst-looking pool in the group, with significant deterioration. Pool 7 (also a Trichlor-treated pool), which had a slightly aggressive startup process and five aggressive water readings over its eight month maintenance period was reported as being the second best looking pool. These results from the NPIRC indicate something other than aggressive water chemistry as the cause of the deterioration and discoloration of their test pools.

Whenever the calcium level of pool water has been determined to have increased from the original tap water reading, it should not always be assumed that this increase in calcium had to be the result of aggressive water dissolving calcium from the pool plaster surface, and instead may be the result of improper workmanship practices. Additionally, any discoloration of plaster, whether white plaster with dark blotches or gray streaks, or dark colored plaster with white streaks, should not automatically be blamed on aggressive water. If the pool water has been maintained properly and reasonably well, and within APSP standards, a review with the plasterer regarding the quality and workmanship of their product is appropriate. Fortunately, todayȇs technology provides the ability to analyze pool plaster for its water-to-cement ratio, the content of calcium chloride, and whether etching has occurred due to aggressive water or whether the plaster has simply deteriorated and discolored due to improper plastering practices.

Another known improper plastering practice which correlates to the effects of a high water/cement ratio, is the act of adding water to a plaster surface while troweling. Doing this increases the waterȉto-cement ratio where the water is added and troweled into the surface. This procedure is known to cause increased laitance, increased porosity, weakness, softness, shrinkage (craze cracking), discoloration, and a non-durable finish. That is why both the ACI and the PCA advise against adding water while troweling a cement or concrete surface, which would include pool plaster.

Finally, reports that claim that temporary and slightly aggressive water (SI -0.1 to -0.3) is the primary cause of deterioration, discoloration, or shrinkage (craze cracking) on new (less than a year old) pool plaster are in error. An important fact that can be learned from this study (and a prior study conducted by onBalance) that bears repeating is that new fresh plaster should be allowed to properly harden and cure for at least six hours before being submerged in water. This is critical to its aesthetic durability. We hope the NPC will acknowledge the need to address these issues in their upcoming Sixth Edition Tech Manual, identify the cause and effect of these improper plastering mistakes, and set strict standards in regards to proper water/cement ratios, calcium chloride additions, and starting the fill water too soon. The pool industry needs well-made plaster that will withstand balanced water.

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