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onBalance challenges Service Industry News

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July 31, 2015

Four separate phases of studies were conducted by scientists of Cal Poly San Louis Obispo in partnership with the NPC from July of 2003 until 2007.

Many of the NPC-funded studies focused on various contributors to spot alteration, etching, craze-cracking and discoloration.

The phases examined the effects of materials and water chemistry to the extent of the defects.

Phase 1 would seem to be a logical starting point.

We find that this study is deficient for analysis however, because not only do the authors admit to difficulty in keeping water balanced, they also don't provide readers with any data to double-check their claims.

Therefore, this issue will examine some of the conclusions from phase 2.

The experiments undertaken in phase 2 were documented in a report entitled "Etching Deterioration of Plastered Swimming Pools Surfaces," by Damian Kachlakev, Ph.D, and Nirupam Pal, Ph.D.

The experiments sought to investigate the effects of water chemistry, sanitizers, start-up procedures, calcium chloride percentages, and other factors on surface deterioration.

To investigate some of these effects, 14 test pools were constructed, with a water-to-cement ratio of 0.5 and 1 percent calcium chloride.

Each of the pools was divided longitudinally into two parts separated by a tile line. One side was plastered without the addition of lubricating water. The other side used supplemental water with 3-to-5 trowel passes.

Plastering day was calm with a temperature of around 65°F during the troweling, which was completed after 6 hours. The pools were filled with water five hours after completion of plastering.

The pools were treated with different start-up procedures and different sanitizers. See accompanying table for details.

Investigators attempted to set water chemistry parameters for the balanced pools to a targeted LSI of about 0.04, while for the aggressive pools, they aimed for a target LSI of between -0.4 to -0.65.

Regular chemical tests were performed every day and the results recorded.

Formal evaluations of the appearance of the test pools were conducted three times during the course of the nine-month study, when the pools were inspected for etching, discoloration and craze cracking.

These observations were recorded in the concluding remarks of the phase 2 document.

The water chemistry parameters were recorded and made available in the document in an accompanying appendix.

From those parameters, it is possible to reconstruct Langelier Saturation Indices for all of the pools, which we have done and provided in accompanying graphs. We do not believe that graphs of this data have ever been published.

Casual inspection of the LSI graphs reveals that most of the balanced pools achieved balance some of the time, but many were out of balance and actually scale-forming for a significant length of time as well. At least one of these "balanced" pools, pool 1, also spent some time in aggressive water.

Neither of the two "aggressive pools" (8 and 13) can truly be considered aggressive. Inspection of their LSI graphs shows that pool 8 spent about 2 months in aggressive water. Pool 13 was not aggressive at all, and actually scale-forming most of the time.

The conclusion made about these test pools in this phase of the Cal Poly research is:

"The research confirmed the phenomenon observed in previous studies that aggressive water chemistry causes significantly more etching deterioration compared to balanced water chemistry and remains the major factor driving the etching development."

However, based on the LSI's of all of these pools, it is hard to understand how anyone could make a statement about aggressive water, since none of the pools truly were.

Closer inspection of the LSI graphs reveals another discrepancy.

After about a month, all of the pools were observed for etching, discoloration, and craze-cracking.

At this time, three of the 11 "balanced" pools were observed to show etching.

This observation refutes the conclusion made in this report that aggressive water caused the etching.

If these pools were balanced, then how can etching have occurred?

Also at this first observation point, both of the "aggressive" pools, one of which was actually scale-forming, were observed to show early signs of etching.

However, this does not support the conclusion made in this report that aggressive water caused the etching.

Since both of the pools had been either scale-forming or balanced at the time of measurement, how can aggressive water have caused the etching?

At the end of the nine-month study, the pools were again observed for etching, discoloration, and craze-cracking. At that time, each of the pools was observed to have etched. Some pools etched worse than others. Three of the 11 "balanced" pools had medium levels of etching.

This evidence does not support the conclusion made in this study that aggressive water caused the etching.

At this time, both of the "aggressive" pools were observed to have experienced severe etching.

Pool 8 was observed to be the most badly etched pool.

This observation doesn't necessarily correlate with the notion that an aggressive environment caused the etching since the pool wasn't substantially aggressive.

The spas were evaluated separately, and both "balanced" and "aggressive" spas were the most severely affected by the etching phenomena.

Examination of their LSI's, however, shows that measured over the length of the experiment, both spas were actually submersed in scale-forming water for much of the 9 months. That both experienced severe etching cannot in any way be linked to aggressive water.

Most pool industry professionals understand that aggressive water causes etching.

Acid will etch plaster — that's a fact. General etching involves eating away the plaster surface, causing a roughened and irregular surface.

But the phenomenon that has been contested is whether or not aggressive water causes spot etching, or spot alteration, as it is also called.

Spot alteration is distinct from general etching. The spots appear white and porous, are generally about ½-inch in diameter and about 1/5-inch deep, randomly distributed, and feel smooth to the touch. The plaster surface surrounding these spots appears gray.

The observations made in phase 2 did not include details about the dimensions or texture of the observed etching, so it is difficult to know what sort of etching was observed, spot alteration or otherwise.

However, at the three observation times, the word "spot" was correlated with the word "etching" for only some of the pools described (see graphs).

At the second observation time, etching spots were described in two of the "balanced" pools, and none of the "aggressive" pools or spas.

That these "balanced" pools spot etched offers a reasonable refutation of the idea that aggressive water caused spot etching in this experiment.

At the third observation time, two pools, the "aggressive" spa 13 and the "balanced" spa 14, were described as having etched spots.

That either spa showed etched spots says nothing about aggressive water, since both spas were actually scale-forming.

It may be nitpicking the data to focus on the term "spot etch," but since the dimensions and textures of the spots were not provided; it seems pertinent to mention this.

To conclude our analysis of the results and conclusions of phase 2 of the Cal Poly San Louis Obsipo Research results:

• The Langelier Saturation Indices calculated from the data of the test pool experiment show that none of the test pools were substantially aggressive for a nine-month duration so it would be difficult to make statements using this experiment about aggressive water causing anything.

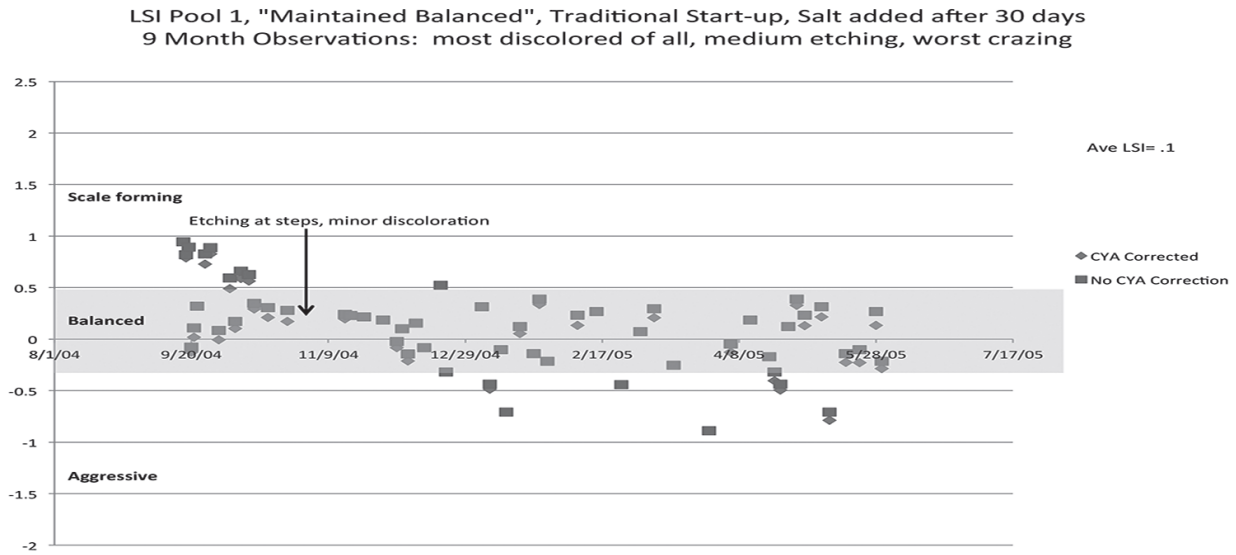
• According to the Langelier Saturation Indices, the pools etched in both balanced and scale forming waters: therefore, aggressive water cannot be the cause of the etching in this experiment.

• The Langelier Saturation Indices that were calculated show that spot etching was observed on balanced pools: Therefore, aggressive water cannot have caused the spot etching in this experiment.

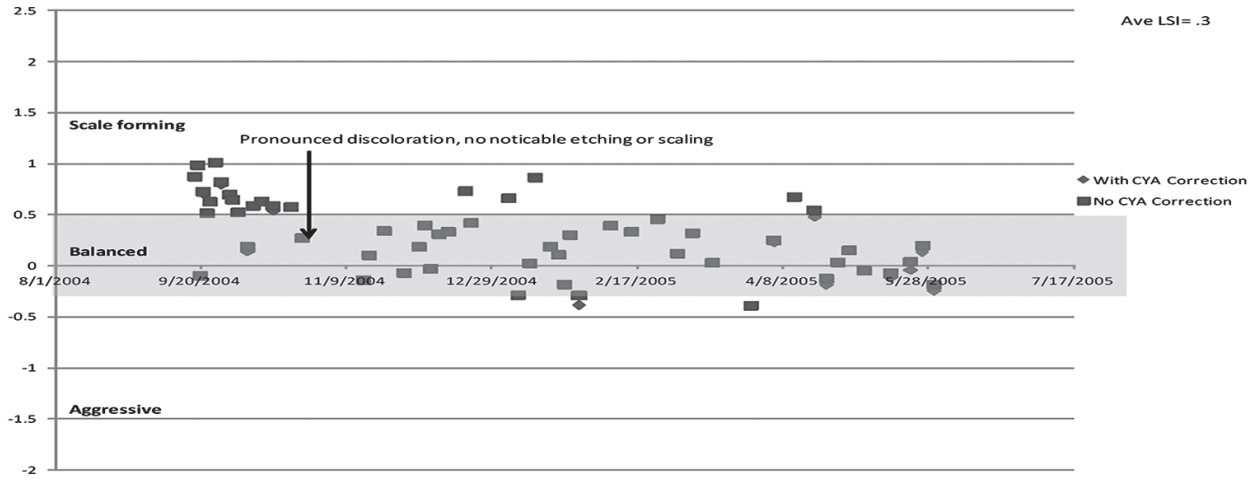
This experiment from phase 2 of the Cal Poly research does not provide any reasonable explanation for the cause of spot etching.

NPIRC Test Protocol Parameters July 2003 Phase 2 Experiments

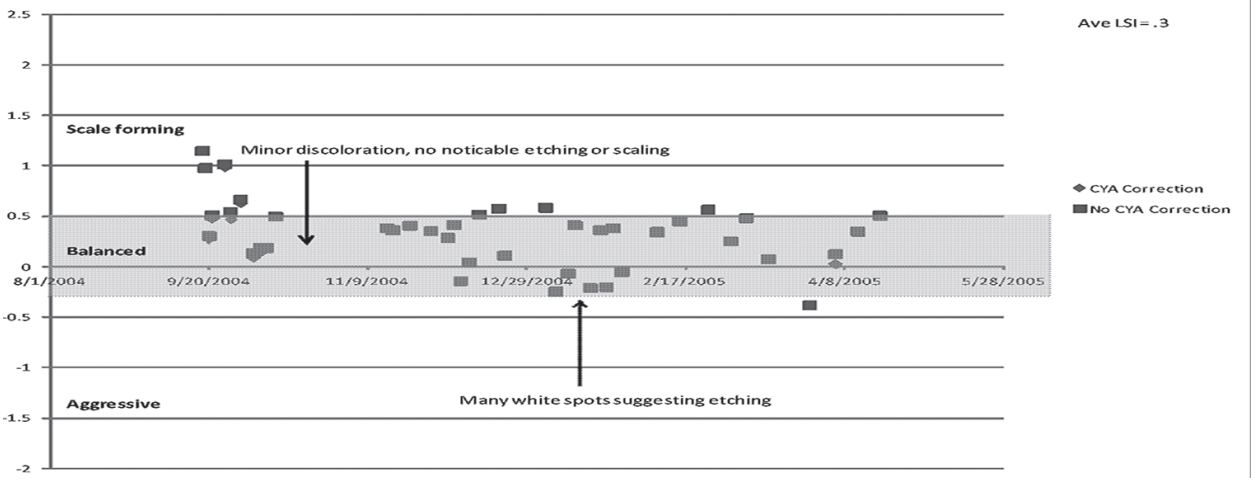
Pool I.D.	Start-Up Type	Stated Water Chemistry	Sanitizer	Comments
1	Traditional	Balanced	Salt	Sanitized with bleach 30 days prior to addition of salt
2	Hydrogen Peroxide	Balanced	Hyd. Peroxide	Abandoned
3	Traditional	Balanced	Bleach	Without stabilizer
4	Traditional	Balanced	Trichlor	Feeder
5	Traditional	Balanced	Salt	Salt added 24 hours after start-up
6	Traditional	Balanced	Dichlor	
7	pH-Neutral	Balanced	Trichlor	1 gal. of bleach added upon start-up. Trichlor floater added on day 15. No acid added in regular maintenance
8	Traditional	Aggressive	Trichlor	Feeder
9	Traditional	Balanced	Bleach	With stabilizer
10	Traditional	Balanced	CalHypo	
11	Acid	Balanced	Trichlor	Rebalanced 3 days after start-up
12	Traditional	Balanced	Trichlor	Borates added at start-up
13	Traditional	Aggressive	Dichlor	
14	Traditional	Balanced	Dichlor	



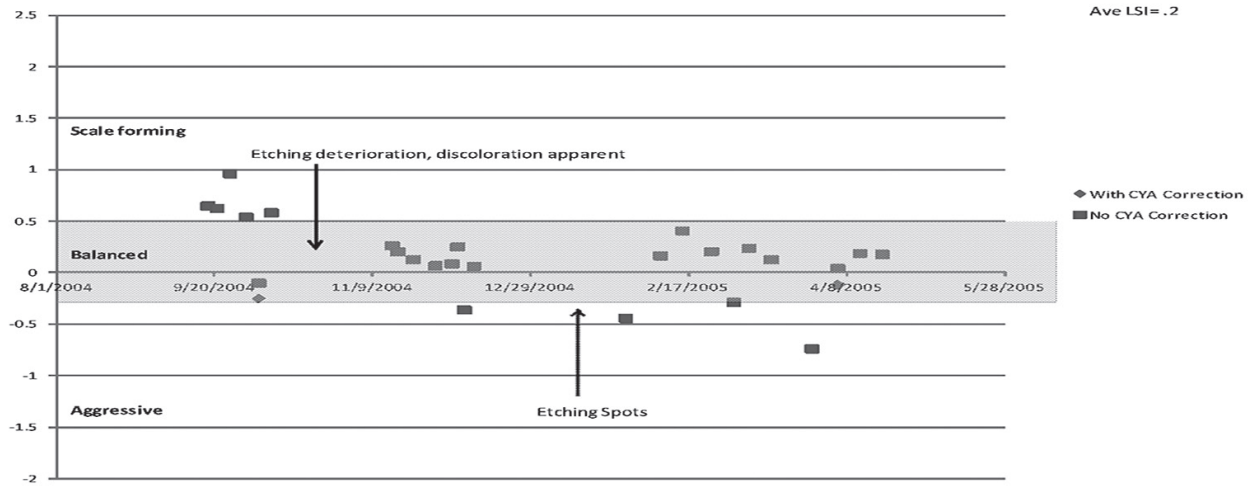
LSI Pool 3 "Maintained Balanced" Traditional Start-up, Bleach
9 Month Observations: minimal etching, small discoloration, some craze cracking



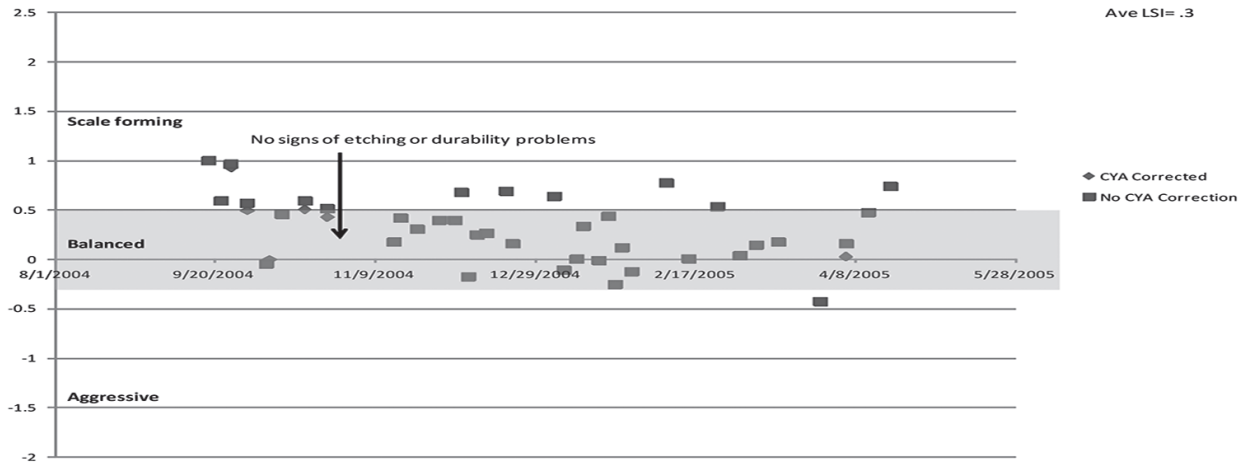
LSI Pool 4, "Maintained Balanced", Traditional Start-up, Trichlor
9 Month Observations: some etching, some discoloration



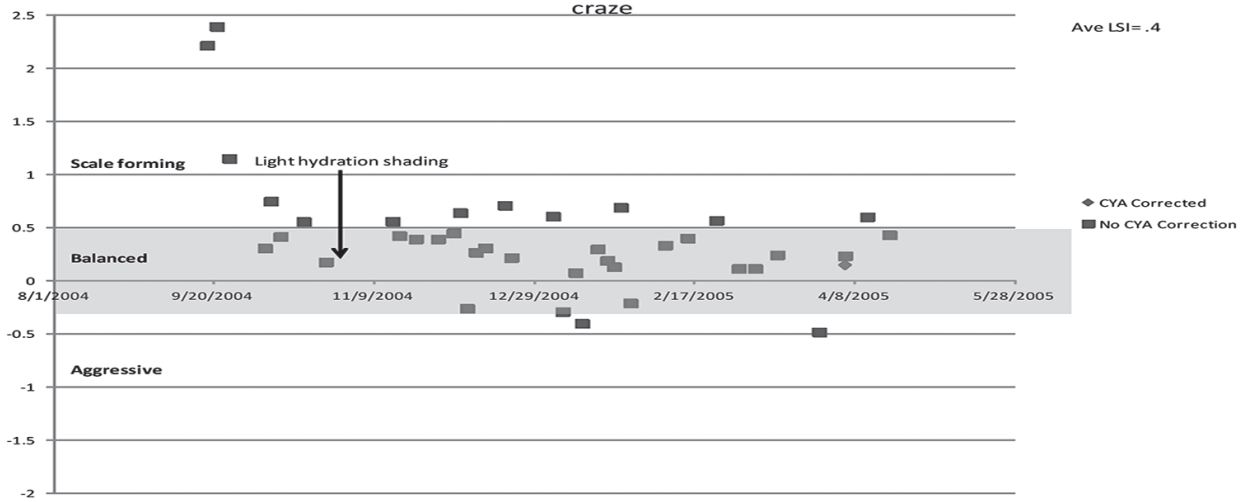
LSI Pool 5, "Maintained Balanced", Traditional Start-up, Salt added after 24 hours
9 Month Observations: significant craze cracking, some etching, some discoloration



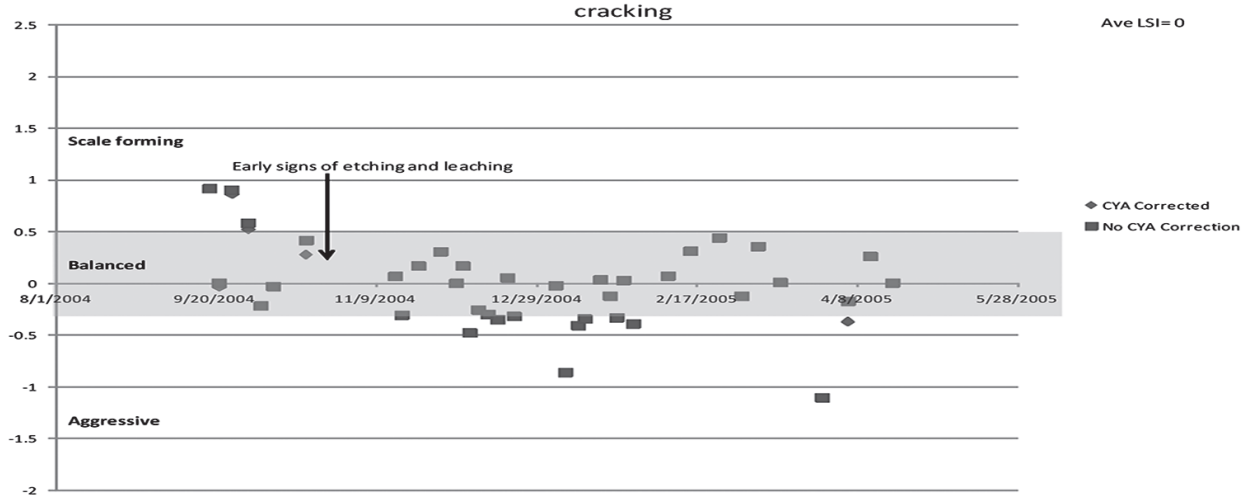
Pool 6, "Maintained Balanced", Traditional Start-up, Dichlor
9 Month Observations: "One of the best preserved pools," minimal etching, some discoloration



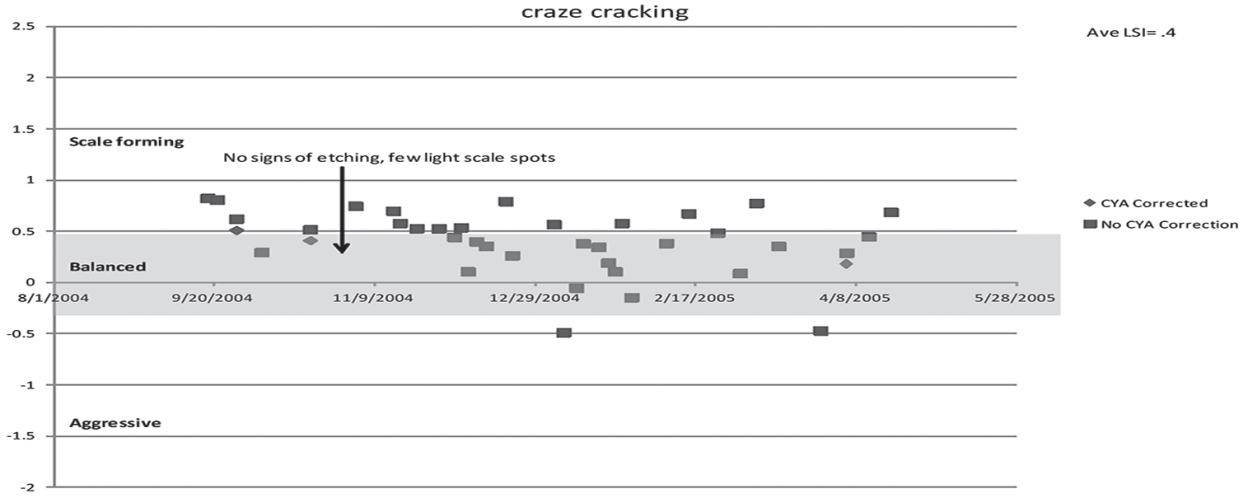
Pool 7, "Maintained Balanced", pH Neutral Start-up, Trichlor
9 Month Observations: very minimal etching, some pronounced discoloration, some craze



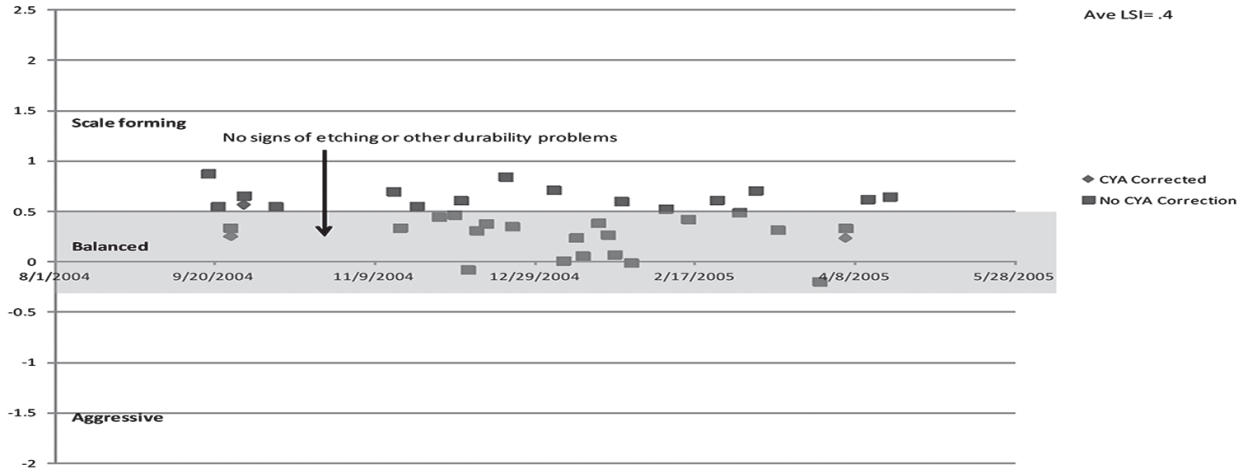
LSI Pool 8, "Maintained Aggressive", Traditional Start-up, Trichlor
9 Month Observations: most pronounced etching, some discoloration, minimal craze cracking



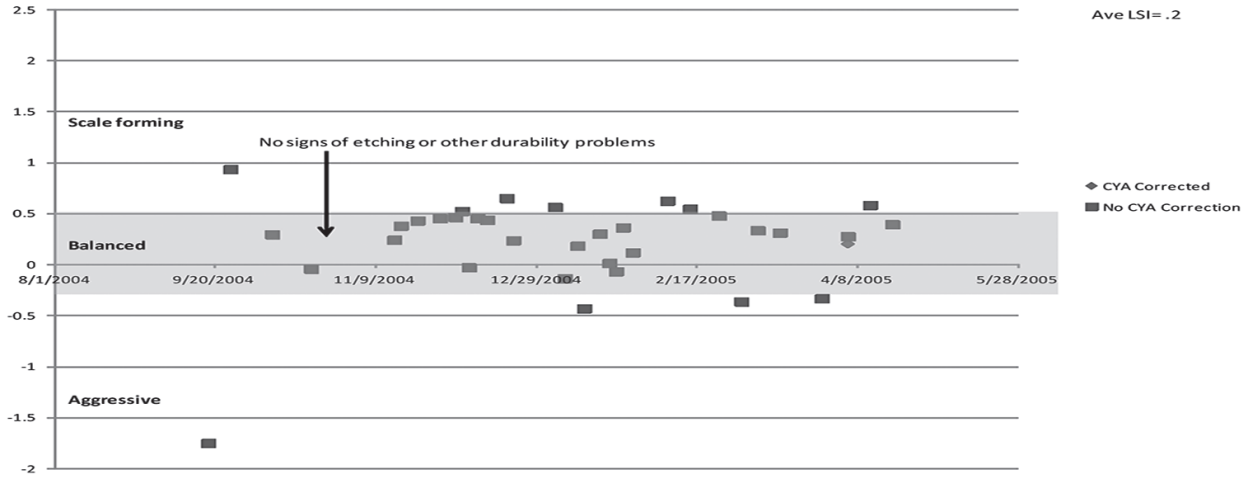
LSI Pool 9, "Maintained Balanced" "No Stabilizer?", Traditional Start-up, Bleach
9 Month Observations: significant discoloration and leaching, minimal etching, light craze cracking



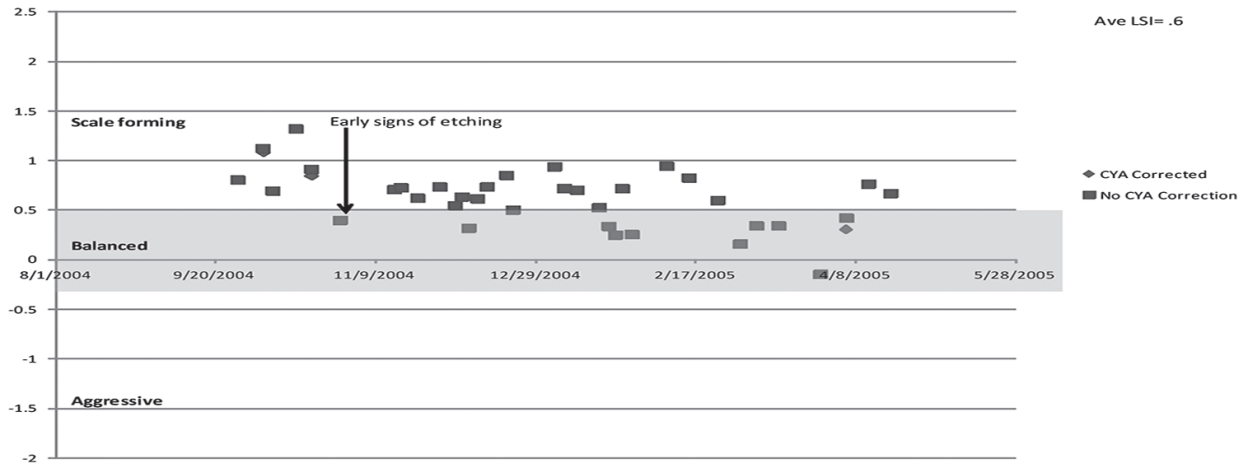
LSI Pool 10, "Maintained Balanced", Traditional Start-up, Calcium Hypochlorite
9 Month Observations: light etching, some discoloration, cracking but likely not craze



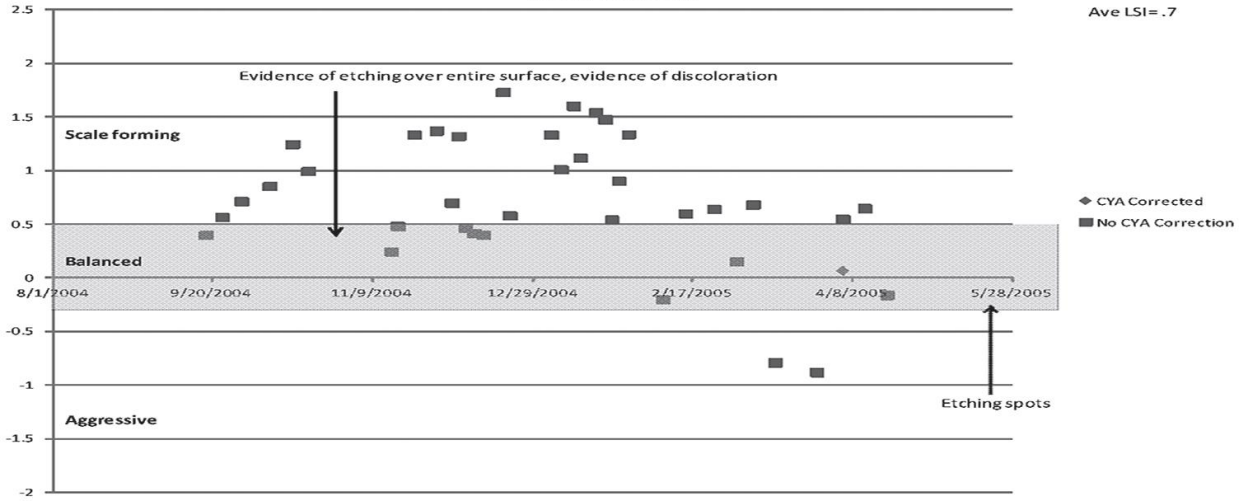
LSI Pool 11, "Maintained Balanced", Acid Start-up, Trichlor
9 Month Observations: minimal etching, some discoloration, some craze cracking



LSI Pool 12, "Maintained Balanced", Traditional Start-up, 50 ppm borate, Trichlor
9 Month Observations: heavy discoloration, scaling, and craze cracking, minimal etching



LSI Spa 13, "Maintained Aggressive", Traditional Start-up, 102°F-12 hours a day, Dichlor
9 Month Observations: worst etching of all, no discoloration, heavy cracking but not likely craze cracking



LSI Spa 14, "Maintained Balanced", Traditional Start-up, 102°F-12 hours a day, Dichlor
9 Month Observations: heavy spot etching, pronounced discoloration