Softening Pools by Precipitating Calcium

onBalance – Que Hales, Doug Latta and Kim Skinner

The industry standard for calcium hardness in swimming pools is to maintain a minimum of 150 ppm calcium as $CaCO_3$, an ideal range of 200 to 400, and a maximum of 1000 ppm. Of course, these levels are to be viewed in the context of the overall Saturation Index balance of the water.

When the pool water calcium hardness level exceeds 1000 ppm, or when it becomes difficult to maintain the SI properly, it may become necessary to lower the calcium hardness level. Traditionally this is done by partially or completely draining the pool, and replacing the hard water with relatively softer tap water.

Sometimes draining is the right thing to do, for lowering TDS, salt, calcium hardness, cyanuric acid, and disinfection byproducts. The saying goes "The solution to pollution is dilution."

However, there may be times when that is not optimal. These situations may include high water tables, cost of water, poor quality replacement water, a desire to not "waste" water especially in drought areas, hot temperatures risking spalling, etc.

When draining a pool is not feasible, there is an alternative that service technicians may use. Remember when you added soda ash to a pool and you were too lazy to work it in evenly and "gently?" That time when you just "dumped it in" all in one spot? Especially, when you did it in the shallow end? Remember when the pool "milked?" The pool looked like it was filled with milk, not because the soda ash did not go into solution, but because it DID solubilize, but in a way that the pH shot way up in a localized area of the pool, and calcium carbonate precipitated out.

Well, there were three ways of fixing the milked pool – filtering, resolubilizing, or draining and refilling the pool. Filtering removes the precipitate, but usually takes a long time, especially with a sand or cartridge filter. Resolubilizing involves lowering the pH to the 5 range which dissolves the insoluble calcium carbonate back to soluble calcium bicarbonate. That can take time, and then the pool needs to be rebalanced carefully, in order to avoid milking it again. And requiring the pool to be drained can be expensive, and aggravating to the customer.

With that experience under our belts, let us consider the nice, clear pool with calcium hardness over 1000 ppm. If we were to dump 20, 30, 50 pounds of soda ash into the pool (sodium carbonate, NOT sodium bicarbonate or baking soda), we WOULD precipitate calcium. And if we then used a DE filter to remove the precipitate, we would have softened the pool. The pH actually stays roughly the same, since the process of sodium carbonate "going in" and the calcium carbonate "coming out" is relatively neutral to the pH. The alkalinity likewise shifts only moderately. The TDS stays the same since we are removing calcium carbonate on a roughly pound for pound basis with the sodium carbonate we added. So it is primarily only the calcium hardness, or calcium ion concentration that changes.

Here is the chemistry:

Starting Point (using sodium carbonate, or soda ash):
Soluble Calcium Bicarbonate $Ca(HCO_3)_2$ + Added Soda Ash or Sodium Carbonate – Na_2CO_3
Result =
Calcium Carbonate Filterable Precipitate – $CaCO_3$ + Bicarbonate Alkalinity $2NaHCO_3$

Starting Point (using sodium hydroxide, also known as caustic soda or lye):
Soluble Calcium Bicarbonate $Ca(HCO_3)_2$ + Added Caustic Soda or Sodium Hydroxide – NaOH
Result =
Calcium Carbonate Filterable Precipitate – $CaCO_3$ + Water H_2O + Bicarbonate Alkalinity $NaHCO_3$

To give a ballpark idea of the possibilities, in one sample pool we treated for a pool owner the calcium hardness dropped from around 1200 ppm to around 600 ppm after the addition of 70 pounds of soda ash. It took three days of filtering with a DE filter to remove all of the precipitate and achieve sparkling clarity, but it meant he did not have to drain his pool.

Step 1 - Pre-testing the water.

Step 5 - Milking complete.

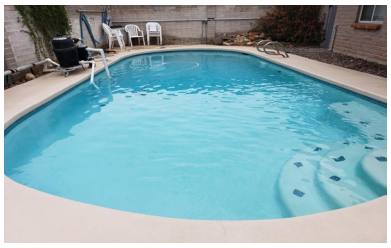
Step 2 - Preparing the DE filter.

Step 6 - Brushing each day to stir things up for the filter and to prevent sticking onto the plaster.

Step 3 - Dumping in the soda ash.

Step 7 - Residue on bottom.

Step 4 - Milking the pool.



Step 8 - Cleared, softened water.

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