Monthly Manager Moments – Article #19

The Importance of Make-Up/Fill Water

Part 4 in our Series on How Pools Work

Why is make-up (or fill) water so important? It really determines what other chemicals you need. A good rule for every operator is to test the fill water immediately before you do anything to the pool with chemicals, and retest it every six months or so. If it seems to change, test it more frequently. It's easy for a skilled operator to overlook the critical nature of the fill water, and become narrowly focused on what is logically used with his/her primary oxidizer. For example, here we have gas chlorine as our primary oxidizer. It is logical to have a base for pH control, since gas chlorine forms two acids when reacting with water: HCl and HOCl. The natural effect of gas then, is to drive down pH and alkalinity. So, do I have a base for pH control? NO! Because the fill water is extremely basic and alkaline, I actually have yet another acid; carbonic acid!

In my last article, I briefly mentioned that the EWU Aquatic Center's make-up water comes from EWU wells, and has a very high Total Alkalinity (TA) of 180 PPM. It also has a very high pH of 7.8. However, when testing the Calcium Saturation Index (CSI), it's nearly zero; perfectly balanced. So, what's the problem? To find out we must look at the entire picture.

To review what this means for an operator, high pH is very undesirable, because it reduces the effectiveness of HOCl (free chlorine) and subsequently reduces ORP. Remember that in order to have pristine water, we need 2/3 oxidation and 1/3 good filtration. Here at EWU, we accomplish that by maintaining an ORP of 850 mV. High pH = poor ORP and poor chlorine effectiveness. Plus, high alkalinity makes the pH difficult to pull down. Any TA value of 150 or more will make the pH very stubborn. It may take repeated heavy doses of a strong acid to pull pH down to the target of 7.3 and TA to 100 PPM. Acid dosing affects both the TA and pH, since they are closely related.

OK, so how was the fill water "balanced" if the values were so far from ideal? Here are the values of the fill water that give a nearly zero CSI: pH = 7.8; TA = 180; CH = 120; Temp = 50. Ideal values are those that not only provide a CSI of zero, but also an ORP of 850 mV. This starts with a low pH value. Here at EWU, we shoot for 7.3. WAC code's minimum is 7.2. The 7.3 target provides a tiny cushion. Since our make-up/fill water has a pH of 7.8, it's really 5X more basic than our target of 7.3. At that pH level, we'd likely need about 10 PPM of HOCl all the time to maintain our 850 mV of ORP. Too much!

The reason that our fill water is balanced when it comes in is because although the pH and TA are way too high, the other two values making up the CSI are very low: Temp = 50°; CH = 120 PPM. Recall that balanced water means it won't eat the pipes, or dump scale on them either. Balance has nothing to do with chlorine or ORP. THAT is the problem! We need to balance the water differently - to also have our target ORP, which means we have to get the pH down.

So, what do we do about it? First, we identify our target values, which are: pH = 7.3; TA = 100 PPM; CH = 300 PPM, Temp = 82°. To get there, we can take one of two approaches: (1.) Slam the pool with lots of acid immediately after refilling, to pull down the TA and pH immediately; and pour in hundreds of pounds of calcium chloride to pull the hardness up to the target of 300 PPM. (2.) Pour in enough acid at refill to pull the TA under 150 and pH to 7.4, add calcium chloride in smaller doses to gradually increase hardness - as the gas chlorine slowly pulls down the TA and pH to 100 and 7.3.

I've done it both ways, but really prefer the second method, to spread out the infusion of chemicals a little more. In this pool it takes 31 pounds of calcium chloride to increase the hardness just 10 PPM. Since I'm starting with only 120 PPM CH and need to get to 300 PPM, that's a difference of 180 PPM. It takes at least 558 pounds of calcium chloride, or eleven 50 pound bags to achieve the target value. For method #1, that's a lot of calcium chloride to dump in at once! It's always better to separate the addition of dissimilar chemicals by at least a day, especially when putting in such large amounts. Acid one day, calcium chloride the next, for example. Another consideration is the addition of gallon after gallon of acid in one day, and the immediate effect on the water. Large acid dosages are quite dangerous, and require hours of mixing time before allowing swimmers into the pool. Even with perfect distribution and skimming, it is wise to allow lots of time for mixing.

This last refill of the EWU pool was unique. Although I tested the fill water at the values noted above, the pH and TA were especially stubborn. I added a total of 24 gallons of HCl before reaching the target values of 7.3 pH and 100 TA. That's a record number for this pool. Again, we have to always look at the big picture – what the AFO course calls the "systems approach." Our filter runs have been quite short since we refilled. Every time the surge tank is drained to clean the filters, 5000 gallons of fill water is used to replace it. That has the undesirable pH and TA, which will fight with the chemicals that I've been adding to pull those values down.

Summary – Hopefully, these examples help to see how critical fill water is; and that it is not only important, but should be the basis for what chemicals are used in your pool. One last thought to drive this home: we will likely switch over to calcium hypochlorite instead of gas chlorine in the future. Here, that will create another problem – calcium hypochlorite is a high pH compound. Not what we want here. How will I deal with it? I'll have to use stronger acids to keep the pH at 7.3. Primary pH control will have to be changed from carbonic acid (a weak acid) to hydrochloric or sulfuric acid. Questions? Email me at leos@ewu.edu.

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