An Artisan's Approach to Water Chemistry

by Steve Kenny

Maintaining superior water quality requires knowledge, skill and an enlightened perspective says veteran builder and servicer Steve Kenny of SRK Pool Services in East Hampton, N.Y. Heavily influenced by his prior career in the culinary arts, Kenny approaches water chemistry with an artisan's touch.

When I sit or swim in water, it always awakens my senses — sight, sound, smell, touch and even taste — all are immediately impacted as I'm transported into a beautifully enlivened state of consciousness. There's just something about being in water that connects with people in an emotional and even spiritual way.

That all sounds great, but what do such musings really mean in the workaday world of the aquatics professional?

In my case, it means specifically that as I keep water's experiential nature in mind, I am driven to ensure our clients' pools consistently deliver the highest water quality possible. Because ultimately, water's profound effect on the senses is why swimming pools and spas exist in the first place. Water quality is not a tangential concern; it's the concern!

Through my years servicing and building pools, I've come to firmly believe that we should regard water quality as our primary selling point. That means implementing water chemistry programs that are based on what I describe as an artisan's approach to "serving" water that appeals to all the senses.

I come by that point of view honestly. Prior to entering the industry, I spent years studying the culinary arts and working alongside some of the finest chefs found anywhere. Through that experience, I gained a profound appreciation for the way fine food appeals to the senses and I always worked hard to serve fare that could satisfy the most discerning of palettes.

Working in water carries the same prime directive: to provide our clients with a product that exceeds their expectations by generating positive effects on their senses.

To do that, you've got to know chemistry and apply with it a chef's expert touch.

Complex Creature

I say all that knowing full well that a great many people in our industry regard water chemistry as a royal pain. After all, it requires the control of multiple chemical parameters, routine and reliable testing, proper application, constant adjustment based on varying conditions and flexibility due to the fact that every single body of water is unique.

Just as every gourmet meal is different based on the ingredients, the style of presentation and especially who's doing the eating, pools and spas have their own sets of nuances, idiosyncrasies and character. They all are in different locations, exposed to varying levels of contamination, experience different bather loads and have clients who like things a particular way.

Indeed, managing water chemistry in multiple vessels requires enormous flexibility, expertise and diligence

Fortunately, there are rights and wrongs in play. Water chemistry is largely settled science, and we can define superior water quality in reliably measurable terms, as well as on the subjective level.

This is an important distinction because for some having water that looks pretty good is good enough, and that can be a mistake. Fact is, you can have relatively appealing water that is still not right chemically, meaning even clear water can be corrosive or scaling and worse, biologically unsafe.

Our clients may have the luxury of judging their water purely by their senses, but as professionals we have to take the discipline to a higher level of certainty. Unfortunately, common sense doesn't stop many people from looking for the quick fix, the magic bullet solution that fixes everything and requires no maintenance.

The problem is that despite the way some products are marketed, there is no such thing as a magic bullet when it comes to water chemistry.

Yes, there are ways we can make achieving great water easier, but ultimately, there really is no shortcut to careful study and hard work.

Layer By Layer

If you take nothing else away from this discussion, embrace the clear reality that maintaining great water quality is a multi-faceted and constant challenge. And remember that when you approach water chemistry from an artisan's perspective, it is transformed from a laborers' chore to the work of the craftsman.

If you look at it the right way, water chemistry is both fascinating and even fun, especially when you're successful at it. Of course, the hard part is learning it and applying what you've learned.

Water chemistry is a multi-layered field of study. There's water balance and the Langelier Saturation Index, sanitization, oxidation, products choices and characteristics, application techniques, testing, automation, troubleshooting, problem solving and remediation techniques.

We'll use the rest of this article to look at most crucial layers and how they fit into the overall water-quality mission:

Balance: When I teach water chemistry to new hires or talk about it with clients, I always start with water balance, which is the foundation for sound water treatment. We've likely all heard the phrase that water is the "universal solvent." That's perfectly true and it's also true that it's a universal scaling agent, depending on its balance. Corrosive water eats away at available mineral sources such as plaster, stone and/or metal components, while basic water deposits calcium compounds and mineral salts onto surfaces, plumbing and internal equipment components. Both phenomena cause damage and compromise water quality.

Using the Langelier Saturation Index (LSI), which as we should know factors in pH, total alkalinity, calcium hardness, water temperature and in later versions, cyanuric acid, I work to stay within plus and minus 2 on the index, the range most commonly recommended for pools and spas. That level ensures that the water will be neither corrosive nor scale-forming. It also works to maximize sanitizer and oxidizer efficiency. I follow basic industry guidelines maintaining pH between 7.4 to 7.6, total alkalinity between 80 and 120 ppm and calcium hardness between 200 and 250 ppm (industry recommendations are actually between 200 and 400).

The first step in managing balance is to test the source water to know where you're starting. I like to set the pH and alkalinity first, in many cases aiming for the low side of the pH range knowing that the

index is going to drift up and to help prevent calcium from clouding the water when added. Once I get those values set, then I move on to other treatment issues, but always circle back and routinely test and calculate the LSI.

Adjusting balance slightly up or down within the recommended range is helpful when you take into account materials. For example, I currently have a pool on service built with highly soluble submerged stone. I know that the stone surface releases minerals into the water, so I set the index on the low side to compensate for the stone's impact on balance.

By contrast, when working with a pebble or tile surface, I'll tip things slightly toward the basic side knowing that those materials release very few minerals because they are less soluble.

(I highly recommend Pentair Pool's online water balance calculator as a tool for determining whether you're in a balanced, scale or corrosive condition. http://www.pentairpool.com/pool-owner/resources/calculators/langelier/index.htm)

A note regarding pH meters: Systems that monitor pH and add acid accordingly are a fantastic and convenient tools, but it is crucial that these systems be properly maintained, cleaned and their readings verified with a chemical reagent test kit. The probes do sometimes accumulate scale, which can impact readings, and it's impossible to know if you're getting accurate readings without test kit verification.

Testing: Without going into detail about testing and test kits, I want to emphasize that you cannot manage water chemistry unless you're conducting routine tests, and taking care to use the test kits exactly as prescribed by the manufacturer. There is no room for shortcutting when it comes to testing. Using the cooking analogy again, you can't bake a cake without exactly measuring the ingredients, otherwise you're leaving the end product completely to chance and odds are the results won't be that appetizing.

The same thing applies when it comes to testing water. If you treat water by adding chemicals absent of testing and based purely on routine or some other non-scientific approach, you're just guessing and may be doing the exact opposite of what is needed.

I use reagent test kits from Taylor Technologies and highly recommend their instruction manual, which I see as one of the most valuable resources available anywhere in the market.

Although I can appreciate the convenience of test strips and allow that they're far better than not testing at all, I strongly favor using reagent tests for their accuracy and information on dosing needs.

Oxidation/Sanitization: These two terms are often mistakenly used interchangeably, due largely to the fact that many compounds do both. Chlorine, bromine and ozone all oxidize and sanitize. By contrast, a UV sanitizer does not oxidize anything, nor do metal ionizing systems.

These are two different creatures and should be considered separately. Oxidation is the burning out of contaminants in the form of organic compounds. Sanitizing is killing pathogens so that they remain below infectious levels.

In our practice, we design treatment systems using ozone and UV. Ozone does the heavy lifting in terms of oxidation while UV has been proven extremely effective in killing pathogens. We also use small amounts of chlorine as a sort of prophylactic measure protecting against the possible spread of infections from momentary bather-to-bather contact via the water. (Not to put too fine a point on it, but human bodies are usually the biggest source of contaminants and microorganisms.) I typically maintain levels of less than 1

ppm in our systems strictly as a back up to the ozone and UV systems.

I'm a huge fan of using ozone and UV as primary oxidizing and sanitizing measures because they are there doing the job anytime the system is running. One of the other reasons using ozone and UV is great because it has zero impact on the index, leaving water neutral.

Of course, you can rely on chlorine solely to do the work of both oxidizing and sanitizing, which according to most health department standards for commercial pools, means maintaining levels of 3 to 5 ppm. Inevitably those levels will add more rapidly to TDS and have a greater impact on water balance, which I'll discuss below. You will wind up with increasing levels of combined chlorine, mostly in the form of various chloramine compounds, which can result in the familiar and undesirable chlorine smell.

Obviously, pools and spas have been maintained using chlorine compounds as the primary oxidizer and sanitizer for decades and it can be done effectively given proper routine maintenance, but it is, I believe, a more challenging way to go when flawless water quality is your goal.

As an example, if a homeowner has a party on Saturday where 50 kids spend the day in the water, any chlorine residual is going to be consumed quickly. If you have an ORP system controlling a chlorine feeder or generator, the system will release large amounts of chlorine to meet the demand. If a service tech or the homeowner sanitizes the pool manually, the water will be left with all of those compounds and possibly bacteria until the next time chlorine is added. All of that is problematic and you may end up having to shock the pool to remove the combined chlorine.

With an ozone system, or in the case of my personal preference, ozone and UV, as the system runs after the party it will oxidize all of those compounds and kill any pathogens automatically, leaving the water safe and ready for use the next morning, without contributing to TDS or combined chlorine levels.

Balance Influence: It's critical to realize that many forms of chlorine will have an impact on the LSI. As examples, trichlor and dichlor will have a negative influence on balance, pushing water toward a more aggressive condition. Calcium hypochlorite, Lithium Hypochlorite and sodium hypochlorite, three of the most commonly used form of chlorine, will move the index toward the positive, more scaling side of the index.

I prefer to use products that have a negative influence on the LSI because I've found most pools (not all) have a tendency to drift in the positive direction and are therefore easier to manage if the sanitizing and oxidizing agents are counteracting that upward movement. Again, that's in my area and in many situations, the exact opposite will be true. In either case, you can actually fine-tune each system to work in your favor if you understand the way that each different product impacts balance.

Because every pool is different you need to record its performance over time and understand each one's specific tendencies as you make product choices. Once we understand a pool or spa's characteristics, I'll choose a sanitizer that enhances balance and ultimately makes it easier to maintain bather comfort and safety.

Stabilizer: Another seemingly obvious point, but one that's often missed, you need to understand the role of cyanuric acid (CYA) in protecting chlorine from UV degradation. Specifically, you need to know which products are stabilized with CYA and those that aren't. Sodium hypochlorite, calcium hypochlorite and lithium hypochlorite are not stabilized and require the addition of cyanuric acid to protect the residual. Trichlor and sodium dichlor are stabilized and are constantly adding to the CYA residual.

There's an ongoing debate about the level at which CYA begins to retard chlorine's ability to oxidize and

sanitize. Also, CYA is now calculated as part of the LSI — the greater the concentration the greater its influence. All of that needs to be taken into consideration when you select a chlorine product.

Clarity Of Purpose

There's really nothing terribly new in any of these chemistry basics. Information about water treatment has been circulating within the industry for decades, with numerous resources available from a range of books, manuals, trade magazines and seminars. Within that sea of information, there are all sorts of varying opinions and unfortunately cases of some manufacturers using pseudo-science to bolster their market positions.

I've found it's useful to maintain both an open mind and a critical eye at the same time when turning to new resources.

Ultimately, however, everything we need to know about water chemistry necessary to deliver great quality water is widely available. The issue really boils down to making use of those resources and taking the water chemistry challenge *seriously*.

As builders, engineers and designers, we can go along way in the right direction by specifying systems that enhance water quality, including not only chemical treatment but also circulation and filtration. As servicers we can do the important work of tracking how these systems perform as we conduct routine testing and make necessary adjustments.

The overall goal is to give our clients the most appealing water we can, because that is what will keep them turning to the water for exercise and fun, and result in them offering invaluable referrals to their family and friends.

After all, our business is water and the better we master its chemistry, the more successful we'll be in creating satisfied customers. That's what artisan chemistry is all about!