Five Critical Factors That Affect Pool Water Chemistry

Compiled and Summarized by Jim Tanner, USFilter (now Siemens Water Technologies)

Pool problems are caused by a number of factors, including chemistry variables, equipment malfunctions or other upsets. The majority of common pool water chemistry problems can be attributed to free available chlorine residual, total chlorine residual, pH, total alkalinity, or calcium hardness – each of which can easily be corrected through careful monitoring, testing and managing.

Free available chlorine is the most important of the five, as it can disinfect and oxidize pathogens in the water. Total chlorine residual and pH are notorious for being misunderstood and mismanaged. Although they require less frequent checking and adjusting, total alkalinity and calcium hardness can lead to pH control problems and possible problems with pool finishes.

These five factors usually cause about 90% of all pool water problems. Such problems can include eyeburn, odor, cloudiness, scale, corrosion, short filter cycles, filter calcification, green algae, water discoloration, pool surface problems, and/or bacterial viral proliferation. While some of these effects may also result from equipment mal-functions or other upsets, quick and inexpensive tests can determine which, if any, of the five critical factors might be to blame.

Free Available Chlorine Residual

Free chlorine is the single most important factor in public pool water management. The only reliable free chlorine testing method is to use a DPD (diethyl-p-phenylene diamine) test kit. Flash readings or refrigerated samples with the OTO (orthotolidine) test reagent are unreliable.

Maximum free chlorine levels vary. Local public health regulations sometimes dictate what the high limit for free available chlorine residual should be. Other pools set the upper limit as the point at which people begin to complain about bleached bathing suits, dry skin and eyeburn.

Ultimately, the ideal target at which to set free available chlorine levels differs per pool. There is no sound evidence that pools maintained at one target residual over another will, in the long run, be better, safer or more comfortable for users. However, when a greater margin for error is needed, a higher target residual should be chosen. Likewise, if a lesser margin for error is needed because of automatic controls or specific expert care, a lower target residual is possible.

Total Chlorine Residual

Total chlorine residual indicates how much chloramine residual is present, compared to free chlorine. This value should never exceed free available chlorine residual by more than 0.5 ppm. Superchlorination ensures chloramine levels remain at or below 0.5 ppm.

pH

The pH factor is rarely harmful to swimmers; however, it can affect the metal, grout and plaster found on pool surfaces and in mechanical equipment. In addition, pH can frequently alter the performance of other chemicals added to the pool, most of which work best at about pH 7.5.

While there are a lot of different pH targets, experts generally agree on a pH that ranges from 7.4 to 7.6. Maintaining such a pH in hypochlorinated, indoor pools is not difficult, where operators can effectively counteract gradual pH shifts. Automatic controls, used on many pools, are also capable of maintaining pH within this range, given a properly sized and working chemical feed pump as well as a proper chemical supply. It is usually far more challenging to maintain such tight pH control in gas chlorinated, outdoor pools without automation.

Controlling pH is the single most important factor in long-term public pool costs. It often explains why one pool mechanical system or plaster finish lasts 35 years while another lasts only three.

Total Alkalinity and Calcium Hardness

These two factors cannot be considered separately, as one's target influences the other's.

Temperature, pH, total alkalinity and calcium hardness are four major factors used to calculate the Saturation Index, which is a measure of water's tendency to scale or corrode surfaces that it touches. The Saturation Index must be considered in picking a target for total alkalinity and calcium hardness. But in pools maintained between 78°F and 85°F and at pH levels of 7.4 to 7.6, temperature and pH can effectively be considered constants, not variables. This somewhat simplifies calculating the Saturation Index.

In general, total alkalinity should be between 50 and 125 ppm and calcium hardness between 200 and 500 ppm. To ensure these factors' levels fall within the appropriate range, total alkalinity times calcium hardness in ppm should equal the number 25,000 — give or take a thousand or two. For instance, if total alkalinity is 50 ppm, calcium hardness should be about 500. Note that this 25,000 rule only works if the pH is between 7.4 and 7.6 and the temperature is between 78°F and 85°F.

Makeup water characteristics, bath load and chemicals used affect precisely where in this total alkalinity and calcium hardness range a pool is operated. Under normal operations, total alkalinity tends to drop in most pools because it is reduced by gas chlorine feed and muriatic acid feed. To counter these constantly declining levels, total alkalinity's lower levels should be maintained between 50 and 80 ppm and countered with higher calcium hardness.

Calcium hardness, on the other hand, is a comparatively stable factor in pool water

chemistry. If total alkalinity falls below 50 ppm, operators can feed calcium chloride at the appropriate dosage to achieve a calcium hardness level that satisfies the 25,000 rule.

New pools that have fresh plaster, grout or concrete can be maintained at a Saturation Index level closer to 30,000 or 35,000 for the first six to 12 months while the surface finish is still new.

Conclusion

Free available chlorine residual, total chlorine residual, pH, total alkalinity, and calcium hardness are perhaps the five most critical pool water care factors that, if not managed properly, can lead to pool water chemistry problems. However, they can be identified and resolved quickly and easily through careful testing and monitoring.

For More Information

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