Application Bulletin
POOL & SPA

Anyone and everyone who is responsible for operating and maintaining a swimming pool or spa has to test, monitor, and control complex, interdependent chemical factors that affect the quality of water bathers are immersed in. Additionally, aquatic facilities operators must be familiar with all laws, regulations, and guidelines governing what these parameters should be.

Why? Because the worst breeding ground for any kind of microorganism is a warm (enough) stagnant pool of water. People plus stagnant water equals morbid illness. That's why pools have to be circulated, filtered, and sanitized – with any number of chemicals or methods, but most frequently with chlorine compounds. However, adding chemicals that kill the bad microorganisms can also make the water uncomfortable, and in some cases unsafe, for swimmers. Additionally, if all the chemical factors of the water are not controlled, the very structures and equipment that hold the water and keep it clean are ruined.

So the pool professional must perform a delicate balancing act with all the factors that affect both the health and comfort of bathers and the equipment and structures that support this. Both water balance – or mineral saturation control – and sanitizer levels must constantly be maintained. This is achieved by measuring pertinent water quality factors and adding chemicals or water to keep the factors within acceptable parameters.

WATER BALANCE

Water is constantly changing. Anything and everything directly and indirectly affects the relationship of its chemical parameters to each other: sunlight, wind, rain, oil, dirt, cosmetics, other bodily wastes, and any chemicals you add to it. **Balanced water not only keeps swimmers comfortable, but also protects the pool shell, plumbing, and all other related equipment from damage by etching or build-up and stains.**

The pool professional is already well acquainted with pH, Total Alkalinity (TA), and Calcium Hardness (CH); along with Total Dissolved Solids (TDS) and Temperature, these are the factors that influence water balance. Water that is in balance is neither aggressive nor oversaturated. Aggressive water lacks sufficient calcium to saturate the water, so it is hungry for more. It will eat anything it comes into contact with to fill its need, including the walls of your pool or spa or the equipment it touches. Over-saturated water cannot hold any more minerals, so dissolved minerals come out of solution and form scale on pool and equipment surfaces.

The **pH** of pool water is critical to the effectiveness of the sanitizer as well as the water balance. pH is determined by the concentration of Hydrogen ions in a specific volume of water. It is measured on a scale of 0-14, 0-7 being acidic and 7-14 being basic.

You must maintain the pH of the water at a level that assures the sanitizer works effectively and at the same time protects the pool shell and equipment from corrosion or scaling and the bathers from discomfort or irritation. If the pH is too high, the water is out of balance, and the sanitizer's ability to work decreases. More and more sanitizer is then needed to maintain the proper level to kill off germs. Additionally, pH profoundly affects what and how much chemical must be added to control the balance. A pH of between *7.2 - 7.6 is desirable in most cases.

*As one of the most important pool water balance and sanitation factors, pH should be checked hourly in most commercial pools. Even if you have an automatic chemical monitor/controller on your system, you need to double-check its readings with an independent pH test. With salt-water pools, pH level goes up fast, so you need to check it more often. Tests are available that require reagents and subjective evaluation of color depth and hue to judge their pH. But different users interpret these tests differently, and results can vary wildly. **Myron L's PoolPro™ gives instant lab-accurate, precise, easy-to-use, objective pH measurements, invaluable in correctly determining what and how much chemical to add to maintain water balance and effective sanitizer residuals.**

Total Alkalinity (TA) is the sum of all the alkaline minerals in the water, primarily in bicarbonate form in swimming pools, but also as sodium, calcium, magnesium, and potassium carbonates and hydroxides, and affects pH directly through buffering. The greater the Total Alkalinity, the more stable the pH. *In general, TA should be maintained at 80 – 120 parts per million (ppm) for concrete pools to keep the pH stable. Maintaining a low TA not only causes pH bounce, but also corrosion and staining of pool walls and eye irritation. Maintaining a high TA causes overstabilization of the water, creating high acid demands, formation of bicarbonate scale, and may result in the formation of white carbonate particles (suspended solids), which clouds the water. Reducing TA requires huge amounts of effort. So the best solution to TA problems is prevention through close monitoring and controlling. **Myron L's Alkalinity Test Kit comes with sodium hydrogen sulphate tablets and a mixing/measuring vial to determine alkalinity in parts per million.**

The other water balance parameter pool professionals are most familiar with is **Calcium Hardness (CH)**. CH is the calcium content of the water and is measured in parts per million. Low CH combined with a low pH and low TA significantly increases corrosivity of water. As the water becomes more aggressive, the solubility of calcium carbonate also increases. This means that plaster and marcite pool finishes will deteriorate quickly because calcium carbonate is a major component of both plaster and marcite. Low CH also leads to corrosion of metal components in the pool plant, particularly in heat exchangers. Calcium carbonate usually provides a protective film on the surface of copper heat exchangers and heat sinks. This thin layer prevents much water-to-metal interaction but does not adversely affect the heating process. Without this protective layer caused by low CH, heat exchangers and associated parts can be destroyed prematurely. Strangely enough, as water temperature increases, solubility of calcium carbonate decreases. *The recommended range for most pools is 200 - 400 ppm. Calcium hardness should be tested at least monthly and has the least significant effect on the water balance when compared to pH and TA.

Total Dissolved Solids (TDS) is the sum of all solids dissolved in water. If all the water in a swimming pool was allowed to evaporate, TDS would be what was left on the bottom of the pool – like the white deposits left in a boiling pot after all the water has evaporated. Some of this dissolved material includes hardness, alkalinity, cyanuric acid, chlorides, bromides, and algaecides. TDS also includes bather wastes, such as perspiration, urine, and *others*.

TDS is often confused with Total Suspended Solids (TSS). But TDS has no bearing on the turbidity, or cloudiness, of the water, as all the solids are truly in solution. It is TSS, or undissolved, suspended solids, present in or that precipitate out of the water that make the water cloudy.

High TDS levels do affect chlorine efficiency, algae growth, and aggressive water, but only minimally. TDS levels have the greatest bearing on bather comfort and water taste – a critical concern for commercial pool operators. At levels of over 5,000 ppm, people can taste it. At over 10,000 ppm bather towels are scratchy and mineral salts accumulate around the pool and equipment. Still some seawater pools comfortably operate with TDS levels of 32,000 ppm or more.

As methods of sanitization have changed, high TDS levels have become more and more of a problem. *The best course of action is to monitor and control TDS by measuring levels and periodically draining and replacing some of your mature water with new, lower TDS tap water. This is a better option than waiting until you must drain and refill your pool, which is not allowed in some areas where water conservation is required by law. However, you can also decrease TDS with desalinization equipment as long as you compensate with Calcium Hardness. (Do not adjust water balance by moving pH beyond 7.8.)

Regardless, you do need to measure and compensate for TDS to get the most precise saturation index and adjust your pH and Calcium Hardness levels accordingly. *It is generally recommended that you adjust for TDS levels by subtracting one tenth of a saturation index unit (.1) for every 1,000 ppm TDS over 1,000 to keep your water properly balanced. When TDS levels exceed 5,000 ppm, it is recommended that you subtract half of a tenth, or one twentieth of unit (.05) per 1,000 ppm. And as the TDS approaches that of seawater, the effect is negligible.

Hot tubs and spas have a more significant problem with TDS levels than pools. Because the swimmer load is relatively higher, more chemicals are added for superchlorination and sudsing along with a higher concentration of bather wastes. The increased electrical conductance that high TDS water promotes can also result in electrolysis or galvanic corrosion. Every hot water pool operator should consider a TDS analyzer as a standard piece of equipment.

A TDS analyzer is required to balance the water of any pool or spa in the most precise way. **Myron L's PoolPro and POOLMETER™ immediately display TDS levels to correctly calculate your water's saturation index**

and to ensure you take corrective action before TDS gets out of hand.

Temperature is the last and least significant factor in maintaining water balance. As temperature increases, the water balance tends to become more basic and scale-producing. Calcium carbonate becomes less soluble, causing it to precipitate out of solution. As temperature drops, water becomes more corrosive.

In addition to helping determine water balance, temperature also affects bather comfort, evaporation, chlorination, and algae growth (warmer temperatures encourage growth). **Myron L's PoolPro also precisely measures temperature to one tenth of a degree at the same time any other parameter is measured.**

The formula for determining water balance is called the **Langlier Index**, or Saturation Index. It is determined by the following formula:

SI= (pH + TF + CF + AF) – 12.1

Where TF is the temperature, CF is Calcium Hardness, and AF is Total Alkalinity adjusted for temperature. 12.1 is the Total Dissolved Solids constant. Consult appropriate conversion charts to obtain the correct values for each variable.

- ***An index between -0.5 and +0.5 is acceptable pool water.***
- ***An index of more than +0.5 is scale-forming.***
- ***An index below -0.5 is corrosive.***

pH, Total Alkalinity, and Calcium Hardness are the big three contributors to water balance. *Pool water will often be balanced if these factors are kept within the recommended ranges.

SANITATION

The most immediate concern of anyone monitoring and maintaining a pool is the effectiveness of the sanitizer – the germ-killer. There are many types of sanitizers, the most common being chlorine in swimming pools and bromine in hot tubs and spas. The effectiveness of the sanitizer is directly related to the pH and, to a lesser degree, the other factors influencing water balance.

To have true chemical control, you need to monitor both the sanitizer residual and the pH and use that information to chemically treat the water – that's where ORP comes in. ORP indicates the ability of oxidizers to burn up organic matter in the water, which means your water is clean and sanitary. There are colorimetric tests used to determine the amount of effective sanitizer for chlorine and other elements, but none is as objective and precise in determining the total killing power of all sanitizers as ORP.

ORP stands for Oxidation Reduction Potential (or REDOX) of the water and is measured in millivolts (mV). The higher the ORP, the greater the killing power of all sanitizers, not just free chlorine, in the water. ORP is the only practical method available to monitor sanitizer effectiveness. Thus, every true system of automatic chemical control depends on ORP to work.

The required ORP for disinfection will vary slightly between disinfecting systems and is also dependent on the basic water supply potential, which must be assessed and taken into account when the control system is initialized. *650 mV to 700 - 750 mV is generally considered appropriate.

Electronic controllers can be inaccurate and inconsistent when confronted with certain unique water qualities, so it is critical to perform manual testing with separate instrumentation. *For automatic control dosing, it is generally recommended that you manually test pH and ORP prior to opening and then once during the day to confirm automatic readings.

*Samples for confirming automatic control dosing should be taken from a sample tap strategically located on the return line as close as possible to the probes in accordance with the manufacturer's instructions. If manual and automatic readings consistently move further apart or closer together, you should investigate the reason for the difference.

ORP readings can only be obtained with an electronic instrument. Myron L's PoolPro provides the fastest, most precise, easy-to-use method of obtaining ORP readings to check the effectiveness of the sanitizer in any pool or spa. This is the best way to determine how safe your water is at any given moment.

SALTWATER SANITATION

A relatively new development, saltwater pools use regular salt, sodium chloride, to form chlorine with an electrical current much in the same way liquid bleach is made. As chlorine – the sanitizer – is made from the salt in the water, it is critical to maintain the **salt concentration** at the appropriate levels to produce an adequate level of sanitizer. It is even more important to test water parameters frequently in these types of pools and spas, as saltwater does not have the ability to respond adequately to shock loadings (superchlorination treatments).

Most saltwater chlorinators require a *2,500 – 3,000 ppm

salt concentration in the water (though some may require as high as 5,000-7,000 ppm). This can barely be tasted, but provides enough salt for the system to produce the chlorine needed to sanitize the water.

(It is important to have a good stabilizer level – *30 - 50 ppm – in the pool, or the sunlight will burn up the chlorine. Without it, the saltwater system may not be able to keep up with the demand regardless of salt concentration.)

Taste and salt shortages are of little concern to seawater systems that maintain an average of 32,000 ppm. In these high-salt environments, you need to beware of corrosion to system components that can distort salt level and other parameter readings.

Additionally, incorrect salt concentration readings can occur in any saltwater system. The monitoring/controlling components can and do fail or become scaled—sometimes giving a false low salt reading. Thus, you must test manually for salt concentration with separate instrumentation before adding salt.

You must also test salt concentration manually with separate instrumentation to re-calibrate your system. This is critical to system functioning and production of required chlorine. **Myron L's PoolPro conveniently tests for salt concentration at the press of the button as a check against automatic controller systems that may have disabled equipment or need to be re-calibrated.**

As you can see, there are many factors affecting the comfort and sanitation of pool and spa water and the functioning of the equipment and structures that hold it, and no one instrument or method can be used to determine ALL of them. BUT Myron L's PoolPro gives you the most precise and comprehensive water testing instrument in one easy-to-use, handheld waterproof unit. Where precision counts, we've got you covered.

RECORD KEEPING – WHAT TO DO WITH ALL THOSE MEASUREMENTS …

Now that you have the data, you have to correctly transcribe, evaluate, and report it to the proper government agencies, or at least archive it as permanent record of proper compliance to whatever regulations apply to your pool or spa. (As if sanitizing and balancing the chemistry of the water wasn't enough.)

*It is recommended (by the World Health Organization and other entities) that data handling be done objectively and that data be recorded in a common format and in the most accurate way. Also, data should be stored in more than one permanent location and made available for future analysis. *Most municipalities require commercial aquatic facilities to keep permanent records on site and available for inspection at any time.

*Myron L's PoolPro makes it easy to comply with data record requirements. The PoolPro is an objective means to test ORP, pH, TDS, temperature and the mineral/salt content of any pool or spa. You just rinse and fill the cell cup by submerging the waterproof unit and press the button of the parameter you wish to measure. You immediately get a standard, numerical digital readout – no interpretation required – eliminating all subjectivity. Up to 100 date-time-stamped readings can be stored in memory and then later transferred directly to a computer using our uDock™ accessory package. You just set the unit on the uDock and download the data to the computer. The user never touches or tampers with the data, reducing the potential for human error in transcription. The data can then be imported into any program necessary for record-keeping and analysis. *The uDock is the fastest, easiest, best way to keep records that comply with governing standards.

Myron L's PoolPro is *SIMPLY* the best.

**Consult your governing bodies for specific testing, chemical concentrations, and all other guidelines and requirements. The ranges suggested here are meant as general examples. Myron L Company assumes no responsibility for lack of compliance to specific regulations governing the testing and control of parameters in your pool and/or spa.*

FOR ADDITIONAL INFORMATION, PLEASE REFER TO MYRON L DATA SHEETS, VISIT OUR WEBSITE AT WWW.MYRONL.COM, OR CONTACT US BY PHONE, FAX, OR EMAIL (SALES@MYRONL.COM).

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