

WATER CHEMISTRY

The most important aspect of caring for your pool, maintaining equipment and surfaces, and keeping the pool sparkling and pleasant to swim in is proper water chemistry. Learning the basics of water chemistry will pay off in money savings, avoiding repairs, and enjoyment of your pool.

The key to pool chemistry is BALANCE. We will discuss step by step what makes a pool balanced, and how to properly test the water to take the guesswork out of knowing for sure if it is in balance or not. We will also discuss what to do to adjust the pools' chemistry properly to achieve balanced water, and how to cope with common pool water problems, such as algae, staining, cloudy water, etc. At the end we will provide a shorter step-by-step guide on what to do and add to achieve optimum water chemistry on a regular basis.

TESTING

There are several methods for testing swimming pool water and spa water and they will vary somewhat in degree of accuracy and ease of use. Home test kits for pools include test strips, liquid titrant kits, and tablet dpd kits. More extensive professional kits are available for commercial pool use but are usually not necessary for testing a home pool or spa. It is important to READ THE DIRECTIONS on whatever test kit you chose to utilize. Test kits vary in the methods they recommend, and, before you get started using one, read the directions thoroughly even if you have used one before and think you know how.

TEST STRIPS

Test strips come in a variety of configurations for testing only chlorine/bromine and pH levels to four- or five-test-in one strips. They have improved in recent years in accuracy but in general are not quite as accurate as titrant testing-liquid test reagents dripped drop by drop in the pool water to effect a color change that is "read". It is important, especially with strips, to note in the directions the depth the manufacturer recommends to dip them, whether they suggest you dip or swirl the strip, the time you immerse and wait for the reaction, and whether they recommend shaking the water off the strip or not. There is a reason the manufacturer suggests certain precise steps, and failure to follow direction can result in inaccurate results.

REAGENT KITS

In the case of the reagent type kits, again, following the directions is vital to accuracy of results. Look at the recommended depth to dip the water block, dip it in an area away from an inlet so return water that has just picked up chlorine from a chemical feeder is not skewing your results, and be sure to fill the tube to the proper level. One easy way to do it is to invert the tube, immerse it to the proper level, turn it upright, and dip the water, than gently flip out the excess water until the water level in the tube lines up with the proper line. You want it right on the line much like you do when you measure liquid in a measuring cup in the kitchen. When you drop the proper number of liquid drops in the tube, keep the reagent bottle totally vertical, not tilted to the side, for accurate drop size. And be sure and cover the tube with the little cap that comes with it rather than your finger so you do not

contaminate the sample. Then, follow directions inverting gently or swirling to mix the sample.

DPD TABLETS

If you are using a kit with dpd tablets, make sure not to touch the tablet when you drop it in. Read the results by placing the plain white side of the directions card behind the sample so you can see the color properly.

WATER CHEMISTRY BASICS

There are very specific parameters for balancing pool water, in order that the water stays clear, free of bacteria, and comfortable to swim in. In addition, proper water balance protects pool equipment and the surface of the pool and prevents costly repairs to them. Balancing is the act of keeping the pool water from being corrosive or scaling. Sanitizing the water is the act of keeping the water sanitary to swim in. They interact in that only 25% of your chlorine is free to kill germs when the pH of the water is 8 or higher and is 75% free and available at a pH of 7 or lower. However, at a pH level of 7 you will be corroding the plaster, pool and equipment, so you will need to keep the pH at a level of 7.4 to 7.6, as we will discuss further in the pH section below.

WATER BALANCE

Trying to save money on pool chemicals by not using what is needed, is THE MOST EXPENSIVE way to care for a pool, the hardest and the least efficient. Proper water chemistry is not costly or difficult, and will pay for itself many times over. You can literally save thousands of dollars over the life of a pool by reading and heeding this advice.

pH

pH or Potential Hydrogen Ion Concentration is a scale we use to measure the active acidic or basic nature of water. The acceptable range for pool or spa water is between 7.2 and 7.8, with the ideal being 7.4 to 7.6. If the water is below 7.2, it is too acidic in nature and causes several problems, including a burning feeling of the eyes for swimmers, corrosion of metal, such as pool equipment-pump impellers, heaters, etc., lower sanitizer effect, rapid dissipation of chlorine, and etching (roughening) of the plaster.

RAISING pH

The chemical used to raise pH is soda ash (sodium carbonate). Using a suitable test kit, check pH and if it is below 7.2 add soda ash as follows:

- Below 6.6 add 16 oz. (1 lb) per 10,000 gallons of pool water.
- 6.6 – 7.0 add 12 oz. per 10,000 gallons of pool water.
- 7.0 – 7.2 add 8 oz. per 10,000 gallons of pool water.

NOTE: Do not add more than 16 oz (1 lb) of soda ash per 10,000 gallons of water during any one application.

Pre-dissolve soda ash in a plastic bucket of water and add to the deep end of the pool. **Always have the pool or spa pump and filter operating when soda ash is being added to mix it up and to kick the pH into balance.** Let the pool circulate at least four hours and then check the pH level again. If the reading is still not within the 7.2 to 7.6 range, repeat the application procedures again until it is in the proper range.

LOWERING pH

The chemical used to lower pH is dry acid (sodium bisulfate) or muriatic acid (diluted hydrochloric acid). Using a suitable test kit, check pH and if it is high, above 7.8, this means that your water is too alkaline. Alkaline water is the cause of eyes burning, scaling of pool equipment and plaster surfaces, a scaly buildup similar to what can build up in your coffee pot. If not brought back into proper range, it can scale up and ruin pool heaters, even completely clog up pool plumbing lines, and deposit a motley, grayish, rough deposit all over the plaster. **High pH also makes chlorine react too slowly to be as effective as it should be and lowers sanitizer levels, and may make the water appear cloudy.** Just as you use vinegar, an acid, to “eat” scale out of your coffee pot, you add an acid to lower pH to the proper level in your pool or spa. Either of the two forms of acid may be used.

***ALWAYS ADD ACID TO WATER, NEVER ADD WATER TO ACID.**

Assume you have checked the pH with a reliable test kit and found it be high, above 7.8. If you are using muriatic acid to lower pH over 7.8, use the following dosage:

- If pH is 7.6 – 7.8, add 12 liquid oz per 10,000 gallons of pool water.
- If pH is 7.8 – 8.0, add 16 liquid oz (1 pint) per 10,000 gallons of pool water.
- If pH is 8.0 – 8.4, add, add 24 liquid oz per 10,000 gallons of pool water.
- If pH is over 8.4, add 32 liquid oz (1 quart) per 10,000 gallons of pool water.

To lower pH with dry acid, the following procedure applies:

- If pH is 7.6 – 8.0, add 1 lb. dry acid per 10,000 gallons of pool water.
- If pH is 8.0 – 8.4, add 20 oz. of dry acid per 10,000 gallons of pool water.
- If pH is above 8.4, add 24 oz. of dry acid per 10,000 gallons of pool water.

Do not exceed 1 lb. of dry acid per 10,000 gallons of water at a time; divide it into several treatments if you need. Pre-dissolve dry acid in a plastic bucket of water and pour in the deep end, allowing the pool to circulate for four hours after application. Recheck the pH; repeat the procedures as necessary until pH is at the proper level.

NOTE: DO NOT ALLOW THE pH TO DROP BELOW 7.2 WHEN ADDING EITHER FORM OF ACID, AND NEVER ADD IT TO THE POOL SKIMMER.

NOTE: The amount of acid needed also varies with the level of total alkalinity of the pool water, which we will cover next.

TOTAL ALKALINITY

Total alkalinity is also lowered by acid, so be careful not to lower it too much when you add acid. Both should be checked and adjusted correctly.

Total Alkalinity is the second factor of water balance, and can be thought of as a buffering agent for pool water. Maintaining total alkalinity at the proper level minimizes pH

“**BOUNCE**” – it helps “**HOLD**” the pH at the correct level so that it is less likely to get out of control and create the other problems we discussed in the previous section on pH. The acceptable level for total alkalinity is 80-120 parts per million (ppm).

If total alkalinity is low, the pH can bounce around and get out of its ideal range and the water is corrosive, damaging pool equipment, etching plaster similar to what happens when the pool is too acid. Often these conditions go together.

The total alkalinity is increased using an alkalinity increaser (sodium bicarbonate) (baking soda). Check the total alkalinity with a reliable test kit. If it is below 80, add 4 lbs. sodium bicarbonate per 10,000 gallons of pool water to raise the total alkalinity 30 ppm. Add the product directly to the pool water with the pump running, and circulate the pool water at least four hours. Retest the water and repeat if needed.

If the pool water tests above 120 ppm, it has high total alkalinity, which can be lowered with muriatic acid (dilute hydrochloric acid), or dry acid (sodium bisulfate), the same chemicals used for lowering pH. Proper dosage is as follows:

- Using muriatic acid, add 1.3 qts. of acid per 10,000 gallons of pool water, which will lower it 10 ppm. Allow to circulate for 4 hours after application. Recheck and repeat as needed.
- Using dry acid, add 1.6 lbs. to lower 10 ppm per 10,000 gallons of pool water. Do not add near metal fittings, like pool lights or handrails, or through the skimmer, and pre-dissolve the product in a plastic bucket of water before adding, preferably in the deep end of the pool. Allow pumps to circulate for four hours, retest and repeat as needed.

CALCIUM HARDNESS

The third factor of water balance is calcium hardness, which refers to the amount of calcium in the water. An acceptable level of calcium hardness is between 200 – 350 ppm, with an ideal level for a special plaster pool such as diamond brite at 180 – 200, and a salt-generated chlorine system at 200 – 275. Low calcium hardness is also called “soft” water, and tends to be corrosive.

Calcium chloride salts are used to raise calcium hardness to a non-corrosive level. After determining the water has low hardness with a reliable test kit, add calcium chloride by pre-dissolving it in a plastic pail of water at the rate of 4 cups (2 lbs.) per 5,000 gallons of pool water to raise it 40 ppm. Add it around the perimeter of the pool, and don't be concerned, but do be cautious, of the heat generated from the product as it dissolves.

Circulate the pool for at least four hours after adding. Calcium hardness increaser may need to be added gradually for a period of time with new pool water with low hardness to “work it up” to the proper level.

High calcium hardness can scale the walls of a pool, and can clog up equipment and plumbing lines with a scale deposit. Excessive calcium hardness levels can also make water appear cloudy.

To reduce excessive levels of calcium hardness, the pool should be partially drained and refilled. It is usually best to get specific instructions for the individual situation from a pool professional prior to partially draining your pool. In general, it is a fairly easy chore that most homeowners can perform. The easiest way is to rent a small portable pump and pump

the water down to the bottom of lowest step and **immediately** refill with fresh water. There are also stain and scale retardant products on the market that sequester, or tie up, and help remove scale from the pool system and filter, as well as help shield pool surfaces from scaling. It is a good idea to add one of these products when a pool is filled with new water, especially in high pH, high calcium hardness, or high alkalinity areas, or any high mineral conditions.

CONDITIONER--STABILIZER--CYANURIC ACID

In order to help hold the chlorine into pool water, to help it stick around and do its job, a pool needs a minimum level of what we call stabilizer or conditioner, also known by its chemical name, cyanuric acid. It is a granular product not found in normal water that must be added to keep the sun's ultraviolet rays from damaging chlorine and making it dissipate too rapidly. The ideal range for cyanuric acid is 40 – 80 ppm and 60 – 80 in salt-generated chlorine systems. A low stabilizer level creates an inability to maintain the chlorine at an adequate level.

Cyanuric Acid (conditioner, stabilizer) is added at the rate of ¼ lb. (½ cup) per 1000 gallons of pool water (1 lb. per 4,000 gallons) directly through the surface skimmer to raise the cyanuric acid level 30 ppm, and the water should then be circulated continuously for 24 hours. Prior to using this product, the filter should be backwashed, the pool super chlorinated and the pH adjusted to the 7.2 – 7.6 range. The filter should not be backwashed for 48 hours after adding stabilizer.

If a pool is using stabilized chlorine tablets for sanitation, however, it is not recommended adding additional stabilizer. The amount that erodes out of the tablets will be sufficient to build up to a proper level within a very short time. In fact, over chlorinating or shocking by running up a high level of tablet chlorine will tend to build up stabilizer to TOO high a level in the pool too quickly. Too much stabilizer actually locks up the chlorine and retards its effectiveness. To reduce cyanuric acid level, drain one foot of pool water for every 10 parts over 100 ppm. Refill and recirculate water for 24 hours, recheck the level and repeat if needed.

TOTAL DISSOLVED SOLIDS (TDS)

Total dissolved solids is just what the name implies, a measure of all the “stuff” dissolved in the water. The ideal range is very wide, 0-2000 ppm, so testing for it is usually not necessary on a regular basis. Total dissolved solids, or TDS, enters a pool from makeup water, calcium hypochlorite shock, calcium chloride hardness increaser, total alkalinity increaser, soda ash, dry acid, people, insects, animals, leaves, grass, etc., and all of this “stuff” in the pool is agitated by circulation.

Total dissolved solid levels that become too high are characterized by murky water, lower filter efficiency, tied-up chlorine, pH imbalance, clogging of cartridge filters, and channeling on sand filters. In order to solve the problem if a high level of TDS occurs, drain quite a bit of the water, refill the pool.

NITRATE AND PHOSPHATE

An alga uses nitrate and phosphate as its two building blocks. Some products have come on the market that removes phosphates to aid in algae control. The only way to remove nitrates, which build up to a high level, is by draining some pool water. High levels of nitrates make an unusually large demand on chlorine usage and come from leaves or debris,

some well water supplies, and fertilizer. Phosphates can enter the pool water from some forms of metal sequestering agents or sometimes from municipal water supplies treated with them for corrosion control.

While the phosphate removal products are effective in removing one of algae's "food" sources, a pool will still need an adequate supply of chlorine to remain algae free, and can, in fact, remain just as algae-free without the phosphate removal additive by proper chlorine treatment. The phosphate removal products are rather expensive, and while aiding in controlling algae they are not really necessary to do so.

KEEPING IT CLEAN

Pool water needs to be balanced according to the above parameters. In order to keep the pool clean, it must be fed a constant supply of sanitizer. A sanitizer is a chemical used to oxidize (burn up) bacteria, algae, and other contaminants. The most common sanitizers used in a pool or spa are chlorine, bromine, and biguanide. Alternative sanitizing agents and methods used more recently are ozone, ion generation systems, and the process of making chlorine in the water with salt generating systems.

Chlorine is the most widely used methods of sanitizing pool water. The types of chlorine include:

1. Calcium hypochlorite (granular shock), with available chlorine of 65% and inert ingredient (calcium) 30 to 35%, and unstablized product.
2. Sodium hypochlorite (liquid chlorine or liquid bleach), with up to 15% available chlorine, also unstablized.
3. Sodium dichloro iso-cyanurate, 63% to 62%, a granular product, 54% to 56% available chlorine, stabilized product.
4. Trichloro iso-cyanurate, available chlorine 84.5% to 90%, stabilized, sold in 1" or 3" tablets.

These products are commonly referred to as shock or calhypo, liquid bleach, dichlor, and trichlor, respectively.

Basically, chlorine works by killing bacteria, virus, and other disease-causing organisms and algae with chlorine molecules and/or chlorine ions. The chlorine invades the cell membrane and causes changes in essential enzymes and structures. It destroys the organisms by oxidation. "Oxidation" is a chemical burning process.

When chlorine is added to water, it forms hypochlorous acid and the hypochlorite ion, which is effective in killing bacteria and oxidizing organic contaminants. Some of the chlorine, however, tends to "bond" chemically with ammonia, forming chloramines. Chloramines are a tied-up form of chlorine that are ineffective for killing the "bad guys" contaminating your pool. When lots of chloramines form, a chlorine smell will be noticed – the chloramines become the "little stinkers" in your pool. When you smell chlorine in your pool, you usually do not have "too much chlorine". You have too many little stinkers – chloramines. And, believe it or not, you do not have ENOUGH free, available chlorine. You smell those tied-up chloramines, and in order to release the tied-up chlorine to do its job and break that chemical bond tying it up with ammonia, your need to ADD more chlorine or non-chlorine shock.

You do this by “shocking” the pool with 2 or 3 times a normal amount of shock to achieve what is referred to as “breakpoint chlorination”. To get to breakpoint chlorination, you must raise the free available chlorine level to TEN times or more the combined level of chlorine.

A normal shock is one-pound granular chlorine (calcium hypochlorite) per 10,000 gallons of pool water. Double this amount to achieve breakpoint chlorination and triple it if there is visible algae present. Chlorine is most active when the pH is on the lower end of the acceptable range, around 7.2, so you may need to add acid to lower the pH to this level.

SANITATION TYPES

How are these different types of chlorines utilized in pools to sanitize them and just what do you use for what? Well, it’s really very simple. First, you need something giving the pool a constant feed of sanitizer.

TABLETS

The tablets come in one or three inch sizes or sticks. Most people find the three-inch tabs give the best rate of feed – not eroding too quickly or too slowly. One inch tabs and sticks work fine, too, but the one inch will erode quickly and the sticks more slowly. All three products can feed the pool by being placed in an erosion-type chlorinator connected to the equipment, in a floating chlorinator in the pool water, or in a skimmer basket in the skimmer. It is not recommended feeding the skimmer basket with tablets or sticks due to the heavily chlorinated water at very low pH is constantly drawn through the suction lines to the equipment and is too corrosive. This is even more important if the pool has a heater as the high chlorine level can corrode or dissolve heater parts.

Fill the chlorinator about once a week and adjust the dial on the feeder to give a regular level of 1.5 – 4 ppm (parts per million) free chlorine level depending upon your climate; the hotter, the higher. Be sure to TURN OFF THE POOL PUMP prior to opening the chlorinator to fill it. According to national standards, the recommended level of free (not tied up as chloramines) chlorine is 1-1.5, but in the south, or any very hot, sunny climate that will NOT be sufficient to keep the pool algae-free. You need 3 – 4 ppm in a hot climate to prevent algae growth.

SODIUM HYPOCHLORITE (Liquid Bleach)

Another form of chlorine used sometimes for both the maintenance dose of chlorines and for shocking is sodium hypochlorite, a liquid, also called liquid bleach. It is sometimes injected into a pool via a special pump for that purpose. It is an inexpensive form of chlorine, but also has lower chlorine content than the dry forms. It also has a very high pH, and can easily scale a pool if not counteracted with the proper amount of acid. Liquid chlorine is un-stabilized and provides only 10% to 12% available chlorine. It will bleach almost any thing it touches and should be handled very carefully to avoid spilling it on anything you don’t want to have bleach spots. 10.5 fluid ounces of liquid chlorine will raise the available chlorine of pool water by 1 ppm (part per million), and to shock, add from 3 quarts up to a gallon of liquid chlorine per 10,000 gallons of pool water.

GAS CHLORINE

A final form of chlorine not used much for home pools but still used some on commercial pools is gas chlorine. There are services in some areas that inject it into home pools as a service, and on some commercial pools it is injected from gas cylinders. In my opinion, gas is **NOT** a good choice for home use because it is extremely dangerous if not handled very carefully. It is the same substance that is referred to as “mustard gas” in World War I. There are better, safer, and more up-to date methods to treat pools, particularly home pools.

CALCIUM HYPOCHLORITE

Your pool should be shocked about once a week during the swimming season. This is where another type of chlorine, the granular calcium hypochlorite, is used. Remember our discussion of combined chlorine, or chloramines, the little stinkers that tie up your chlorine and make the pool smelly with a chlorine smell? Well, we SHOCK the pool with granular shock to reactivate the tied-up chlorine, oxidize organic contaminants, and “burn out” bacteria. Use one pound per 10,000 gallons of pool water about once a week during the swimming season and as seldom as once every month or two if it is cold.

Shock should be mixed with water first and diluted if you have dark plaster or specialty-surfaced pool, but if you have a white plaster pool, you can broadcast it, or just throw it out there into the water. After shocking, run the pump a few hours to mix it up good. It is most effective to shock the pool in the evening when everyone is through swimming, and then it is safe to swim the next day, about 12 hours later. Many families find that Sunday night is a convenient time to shock when the family is through with using the pool over the weekend. Dichlor shock is also a good choice to use; it is recommended especially for spas. It is stabilized and dissolves a little more completely in water, but is a rather expensive option for full-sized pools.

LITHIUM HYPOCHLORITE

Another choice, however, often recommended for dark plaster pools especially, is lithium hypochlorite. It is a granular product that can be broadcast directly into the pool, because it dissolves very quickly. Add 2 pounds per 10,000 gallons of water to shock with lithium hypochlorite. It is more expensive than calcium hypochlorite, however, and the same results can be obtained with the less expensive cal-hypo (for short) even in dark plastered pool by pre-dissolving it.

If, in spite of your best efforts, algae form, it takes three times a normal amount of shock to get rid of it.

BROMINE

Bromine is also an effective sanitizer, but it is recommended mainly for spas rather than pool because of cost. It is especially useful as the regular feeding sanitizer for spas because it is more stable in hot water than chlorine and it is not as inclined to smell in the close quarters of a spa when it combines with ammonia and forms bromamines. It also functions better in high alkaline and higher pH water.

Bromine is available in tablets, which are useful to use as the regular sanitizer, and in granular form, which is good to use to start up a spa or when refilling it to establish a

bromine reserve. Bromine tablets also contain chlorine. Anytime chlorine is in the water, there is a possibility of some chlorine smell.

OZONE OR O-3 GAS

Ozone, or O-3 gas, is a modified form of O-2. It is naturally formed when the ultraviolet rays of the sun split the oxygen molecule. It is an effective sanitizer and is used in pools and spas with an ozone generator, which artificially generates ozone as the air passes by the ultraviolet bulb in the device and is then injected into the return line back to the pool.

Ozone free radicals created are short-lived, react very quickly, and then revert to oxygen. They work more quickly than chlorine and other chemicals to kill bacteria and oxidize organic waste, but they do not maintain a residual to keep on killing and oxidizing. Therefore, a small amount of bromine in a spa and a small amount of chlorine in a pool is still needed when using an ozonator. Ozone will regenerate inactive bromine. Periodic shocking is needed with ozone.

The ozone downside is that it is not sanitizing for long unless the ozonator is on, which means that any money savings you might have in chemicals is quickly eaten up and perhaps surpassed with electricity costs. Also, due to its short sanitation life, ozone may not be able to keep up with the sanitation demands of a full-sized pool, especially if it is located in a hot climate. It is a more practical choice for spas.

ION GENERATORS

Ion generators have come on the market extensively in more recent years as a heavily promoted choice for pool and spa sanitation. These devices are installed at the pool equipment and work by sending copper and silver ions through the pool water to sanitize it. While they cut down on chlorine or bromine usage, they do require a small amount of chlorine or bromine to work.

Although the manufacturers of these products claim they are sequestered, or the metal ions are tied up to prevent their plating out onto the pool surfaces and staining the plaster and even tile, it is the experience of many that it is very difficult to use these products without danger of staining the pool. Given the initial cost, the need to replace the cartridges they use with regular and relatively expensive replacements that are sometimes not widely available, the need for chemical use anyway, and the staining problem, these products have a number of downsides for the average homeowner.

In a hot climate, there is also the difficulty in preventing algae growth with these products; and if the pool is shocked sufficiently with chlorine to prevent or kill algae, the ions are likely to plate out and stain the pool. If you do choose to use this sanitation method, it is highly recommended a regular addition of a stain prevention (metal sequestering) product.

SALT GENERATION SYSTEM

The salt generation system is a method of manufacturing chlorine in the water through the use of an addition of salt and a device installed with the equipment that converts it to chlorine for sanitation. These systems also need periodic shocking but are effective with few downsides other than the initial cost and the mechanical maintenance required of any additionally piece of equipment. They do not involve the staining problem of ion generators or need to run constantly like ozonators. The salt generation system is the most viable alternative sanitation method to chlorine tabs and shock. In hard water areas, additional

sequestering agents may be needed because calcium can collect and harden on the system plates, causing a reduction in the amount of chlorine produced.

NON-CHLORINE SHOCK (Potassium Monopersulfate)

Non-chlorine shock, or potassium monopersulfate, is a granular product which dissolves in water and releases oxygen into the water. Oxygen oxidizes organic material, kills bacteria and algae, and breaks up tied up chlorine and bromine. It is useful in shocking pools right before swimming because it required no waiting time to swim. It is also recommended sometimes for vinyl-liner pools and dark plaster pools because it does not have the bleaching effect of chlorine shock. However, chlorine shock can be diluted in water first to lessen this problem. Non-chlorine shock is more expensive than chlorine shock.

BIGUANIDE (Polyhexamethylene Biguanide)

Biguanide, popularly branded as Baquacil or Softswim (polyhexamethylene biguanide), is another sanitation method for pools and spas. It works to kill bacteria through cell destruction. Biguanide is effective as a sanitizer despite sunlight, heat, and pH levels.

Usually hydrogen peroxide is recommended as a shocking agent in combination with biguanide, and a quaternary ammonia algacide is also suggested. Chlorine, bromine, metallic-based and polydimethyl algacides, persulfate oxidizers and anionic detergent based tile cleaners are not compatible with biguanide.

Downside of biguanide sanitation include cost, problems of easily converting back to chlorine if it proves unsatisfactory, and difficulty in keeping up with sanitation demand in hot climates. There is also a tendency for it to form a slimy consistency that is hard to get rid of.

ALGAE

The best way to avoid algae growth in your pool is to prevent it. Algae spores are plants and these slimy little characters are the omnipresent bane of the pool and spa owner. They tend to sneak up on your pool water before you know it, and all of a sudden they seem to be everywhere, turning your sparkling blue lagoon into a pea-green or mustard encrusted swamp overnight.

The very best way to prevent the problem, though, is by keeping an adequate level of sanitation residual in your pool or spa AT ALL TIMES. You do this by regularly keeping your pool treated with chlorine, or properly treated with an alternative sanitizing system, regular shocking, and proper water balance as we have previously discussed.

However, the world being the imperfect place that it is, most pool owners face the unpleasant prospect of algae problems from time to time. So, we will discuss the various types of algae you might encounter and the fun part: killing it. The algae's you are likely to encounter in your pool include green or free-floating algae, brown (yellow and mustard), blue-green (black), and red (pink algae, pink bacteria). Within these four categories, there are about 20,000-plus known varieties of algae. They mutate and change, causing some to even become immune to chlorine.

GREEN OR FREE-FLOATING

Green, or free-floating, is the kind you get when all of a sudden your pool seems to get pea-green in color, sometimes overnight. It will often happen in hot weather, especially after a rainstorm. Algae will “bloom” in your pool like this when the chlorine (or sanitation level) is too low, or an algae maintenance program is not followed. Rain can seriously dilute your sanitizer, too. That is why it is so important to keep chlorine or sanitation RESIDUAL in your pool at all times, sometimes even higher than the recommended national standards of 1.0 – 1.5 you commonly see on your test kit.

In very hot and moist times of the year you may need to keep the chlorine level at 3-4 ppm to prevent algae growth from forming.

What to do when you have algae bloom on your hands. First, lower pH level to 7.2 – remember chlorine is more active at the lower range of the pH scale. Then, triple shock the pool – instead of adding one pound of granular shock per 10,000 gallons, add three. Also add an algaecide effective for green algae.

Keep in mind, an algaecide does not kill algae. What it does is surrounds the cell of algae and makes it feel sick, causing it to open up so the chlorine kills it. Chlorine kills algae, algaecide facilitates the kill, it helps the chlorine do its job; it’s the supporting force.

Several types of algaecide will be effective in helping the chlorine kill green algae. A recommended algaecide is algaecide 60, a polyquaternary ammonia algaecide. It is stronger and does not foam. An all-purpose, or quaternary algaecide is fine, too and a little less expensive, but it foams, and is supposed to.

You can also use an algaecide formulated especially for green algae, but these are usually copper-based. You get the advantage of an extra killing ingredient with the copper additive, but if label directions are not carefully followed, you risk staining the pool. You should use a metal sequestering product with this as well as a preventative measure. You may be better off to avoid the metal-based algaecides unless there is a severe problem and you have access to knowledge professional help in using them. People have been known to run to the grocery store, grab an algaecide, pour it in the pool, and stain it splotchy aqua with it when they could have gotten rid of the problem with enough chlorine and a properly chosen algaecide product.

Circulate the pool at least 24 hours or until the bloom is gone. Two or three days of continuous run time is not a bad idea. You may also need to give the pool a second chlorine shock in a few days to completely get rid of it. The pool may appear milky at first as well, and it may be important to clean the filter an extra time or two during the process as the algae filters out and clogs it.

A clean, clear pool is dependant on both chemical treatment and filtration. After getting rid of the algae, maintain the pool at a chlorine level of 3-4 ppm in hot weather or climates and 1-2 ppm in cooler climates. In addition, be sure to shock regularly according to season, water temperature, pool use, and rain. In hot weather, a good rule is to shock once a week, or after a heavy rainstorm, or party, especially a party with kids.

BROWN (Yellow or Mustard)

Brown (yellow or mustard) algae are yucky-looking mustard algae that cling to the walls of the pool and are particularly stubborn to get rid of. It is especially insidious because mustard algae spores live outside the water and can easily be reintroduced through the pool brush, pole, floats, toys, etc. or passed from pool to pool.

Brush the pool everywhere you see the yellow. Adjust the pH to 7.2. Add a granular sodium bromine product (follow the label directions for amount) and triple shock the pool. Add an algaecide 60 product as well, following label directions for amount.

In addition, throw in the brush, the pole, floats, toys, etc., any items that have been in the water could be carrying the spores, and leave in the pool overnight during the initial treatment. Run the pool continuously for several days as well. Follow up with a lesser shock treatment for several days thereafter the initial day's treatment.

Finally, make sure to keep the pool at 1.5-2 ppm in a cool climate and 3-4 ppm in warm climates to prevent future growth. Each time you shock the pool, add a backup treatment of a liquid sodium bromide products, which is the most effective way to prevent reoccurrence, a common problem with this type of algae.

BLUE-GREEN, OR BLACK

A blue-green, or black, alga is a stubborn algae that burrows into the wall of the pool with a tenacious root and forms a crust over the top. It looks like little round shape black spots on the pool. The key to getting rid of this type of algae is vigorous brushing with a wire algae brush over several days with aggressive shocking with granular chlorine. An alga is a plant, and it must be killed at the root like a weed. Brushing “knocks the top off” the algae and allows the chlorine to get down into the roots to destroy it. Black algae are most often found in areas of poor circulation. Be sure your inlets are all facing the same direction and angled slightly down. If you need help with this, consult a service professional for help with your circulation system.

The method for getting rid of black algae is as follows: Adjust the pH to 7.2, brush all spots vigorously with a wire algae brush; this will need to be repeated daily until the spots go away. Triple shock with granular chlorine (calcium hypochlorite). Add the recommended dose of algaecide 60 or all-purpose algaecide (polyquat or quateneriammonia algaecide).

Keep chlorine at the recommended level in the future to prevent regrowth and shock regularly. The FREE AVAILABLE CHLORINE level should be at least 1.5-2ppm in the cooler climates and 3-4 ppm in warmer climates.

Sometimes in spite of your best efforts, this method may not be enough to get rid of black algae. Usually, if you brush enough, it will be. But if not, this may call for use of a specially formulated black algaecide that contains copper. Copper is effective in killing algae, but if label directions are not followed, it is possible to stain the pool using it.

A copper-based algaecide should be used with a metal sequestering product (check with a knowledgeable pool professional before use). A strong chlorine shock can precipitate metals out on the wall of the pool as a stain, so it is tricky to use properly. The stain will appear blue or aqua from copper. If metal staining should occur, there are several acid based products, which may be capable of removing the stains.

Red (pink algae, pink bacteria) algae, sometimes called pink slime, are rarer algae that basically come from the sea. It is mainly seen in areas near the ocean, or in a pool where swimmers have been swimming in the ocean and then jumped in the pool in the same bathing suits, or it can be carried into the pool by sea and/or migratory birds. Some forms can actually be a fungus rather than a plant, and it tends to have an oily consistency, hence the name “pink slime”.

To get rid of it, adjust the pH to 7.2, add an enzyme product that combats oil and scum, add a polyquat (algaecide 60) product, and triple shock. Follow label directions on algaecides and enzyme products for amounts, and triple shock the pool with granular chlorine (calcium hypochlorite) at the rate of 3 pounds per 10,000 gallons of pool water.

With all algae's, the basic cause is low sanitizer level, i.e., not enough chlorine. The level should be kept at 1.5-2 ppm in cooler climates, 3-4 ppm in warmer ones. Chlorine, as it does its job, ties up with ammonia, forming chloramines; therefore, it should be reactivated by shocking the pool regularly – once a week during swimming season is a good rule of thumb.

Shocking is best done with granular calcium hypochlorite shock at the rate of one pound per 10,000 gallons, and should be diluted in a bucket of pool water for dark plaster pools, broadcast for white plaster pools.

If there is visible algae, lower pH to 7.2 to make the chlorine more active, triple shock, and add the recommended algaecide products in the above section. Add additional products as recommended for specific algae problems, and brush mustard or black algae's before shocking according to the guidelines we discussed.

CLOUDY WATER

Another problem encountered with your pool or spa may be cloudy water. There can be several reasons for this. A pool or spa needs both proper circulation and filtration and proper chemical treatment to remain clear and sparkling, so if either of these factors is out of whack, the pool may not be clear.

The most common causes of clouding, however, include low chlorine, pH, and/or total alkalinity that are too high, high calcium hardness, or insufficient running time of the pool's circulation/filtration system. It is recommended that the pool pump run at least 6 hours per day in cold weather and 8 to 12 hours per day in hot weather. Run your pump 24 hours a day if the pool is cloudy or has algae problems. To identify the source of cloudiness if you suspect it might be a chemical problem, first test chlorine, pH, and total alkalinity with your home test kit and adjust those to the proper level if they are not. If the pool needs shocking, shock it and run the filter at least 24 hours and see if that clears it up. Keep in mind that the shock itself will make it cloudy temporarily.

If you are still having problems, try using a clarifier in the water. A clarifier works basically as a series of molecular "hooks" grabbing on to particles suspended in the water that are too small to filter out – the clarifier makes them into bigger "clumps" that will trap out in the filter and clear the water. Also, however, make sure your filter is working properly, too, and will do the job. Clean it or backwash it if that is needed.

After several years a pool may need to be partially diluted and refreshed with fresh water, too, as all the things added to the pool over several years tend to build up and raise the total dissolved solids (TDS) level. This can also contribute to clouding.

If you have tried all these methods of coping with cloudiness and given it a few days to see if it will clear and it is still cloudy, you may need a professional pool service person to come and check your equipment to see if it is working properly. If you are seeing "blowback" of sand into the pool in a pool with a sand filter or DE into the pool equipped with a DE filter, you may have a broken sand filter lateral or torn DE element that needs replacing before the

filter will work properly, for example. A properly trained professional service person will be able to troubleshoot and fix any equipment that may be a source of clouding problems.

METALS, MINERALS, STAINING & SCALING

Metals and minerals sometimes are present in pool and spa water, and should be removed or sequestered (tied up) to prevent staining and scaling of pools. It is a good idea to regularly add a metal sequestering product to head off trouble before it starts. It is also valuable to have pool water professionally tested for metals periodically.

A metal and mineral sequestering product, sometimes referred to on the label as a stain and scale prevention product, should be added when pool water shows a metal level of .2 ppm (parts per million) or above, and is advisable to be added on a maintenance basis as directed on the label, usually weekly to biweekly. A good program is to shock one week, add the metal/scale product the next, alternately. Or it can be done weekly but should be added at least one day prior to adding chlorine or algicide.

Metal sequestering products grab the metal, keep it in solution, or help it filter out and keep it from plating out as a stain on the wall of the pool. It is best to run the filter continuously 24 hours after adding it in order to trap as much out of the pool as possible. It also helps prevent scale formation on pool surfaces and equipment, and filter plugging of cartridge or DE filters and channeling or stoppage of sand filters. It increases the life and efficiency of heaters as well, by preventing calcium buildup.

Staining and scaling of pool surfaces, most noticeable in white plaster pools, sometimes results when pool chemicals are out of balance or substances are introduced into the pool from other sources, such as metals, calcium, organic substances such as leaves, dissolved material from rocks, etc. They can be tricky to identify and difficult to get rid of. Proper testing, careful water chemistry balance and maintenance and regular use of a sequestering product are all helpful in prevention. Stains are much easier to prevent than get rid of.

If stains are a problem in your pool there are some remedies. First, it is important to identify the source and type of staining. A copper metal stain will appear as splotchy aqua or blue, while iron stains a rust or black color. Silver ions plating out will also appear black or dark grayish. Scale appears usually as splotchy gray or brown, and is rough to the touch. What gets tricky in identifying stains is that there can be more than one condition present staining the pool.

First, have the pool water professionally tested to see if the water chemistry is out of balance or there are metals present. Then, correct the water chemistry and/or use a metal sequestering product to get rid of metals as indicated and prevent future staining or scaling. Sometimes using an increased dose of one of the metal/scale products will help remove or lessen existing staining, but prevention is their main function.

If the stain is organic, from leaves, for example, the stain will usually disappear with a good dose of granular shock. There are a number of stain removal products on the market, most of which are acid based, to essentially “eat” the stain off the wall. Results vary with the care used in following the directions properly, the proper identification of the stain, and the severity of staining. The guidance of a pool professional particularly knowledgeable of water chemistry is helpful in using these products, and the results can still not be guaranteed.

In cases of severe staining or scaling, usually a pool will need to be drained and acid-washed to remove the stain, if the pool is a gunite pool finished with plaster. Sometimes pool plaster

will roughen due to improper water chemistry, if the pool is kept too acid (low pH), has a low total alkalinity, or has low calcium hardness for a period of time. This condition is called “etching”. It can also literally “eat” the metal out of the heater (copper) and pump impeller (iron) and deposit it in the water, precipitating both etching and staining. That is why it is so vital to watch water chemistry closely.

BATHTUB RING ON TILE

Another problem that can affect pools is the formation of an oil and scum line around the waterline. This is especially noticeable in spas. The problem comes from suntan oil and body oils deposited in the water from swimmers, or organic plants that are oily in nature, or algae.

The solution to this problem is use of an enzyme product that works by breaking down fatty lipids, thus allowing the chlorine or bromine to completely oxidize them out. Regular use of one of these products prevents scum line, helps sanitizers such as chlorine or bromine work more effectively, keeps tile lines cleaner, and keeps filters cleaner reducing the frequency of backwashing and cleaning.

MAINTENANCE 101

Now that you have some background in water chemistry and how to deal with particular problems, we will get more specific on exactly what to do to easily care for your pools water chemistry. The goal is to give you confidence in pool care so you will be able to enjoy clear, clean water, minimize problems, and save money.

Once a week, Test the water with your home test kit and adjust the pH to 7.4 – 7.6 (ideal) or 7.2 – 7.8 (acceptable) by adding the proper amount of either muriatic or dry acid if the pH is too high, or soda ash if the pH is too low. If you chlorinate via a chlorine tower refill the tower with 3-inch stabilized chlorine tablets (trichlor).

During the swimming season, once a week to bi-weekly, or after a heavy rain or party shock the pool with one pound of granular shock per 10,000 gallons of pool water. Optionally, but a good idea, is to also add a maintenance dose of a liquid sodium bromide product with the shock.

Weekly, but not the same day as you shock, add a maintenance dose of an enzyme product, which controls oil and scum and keeps the tile line and filter cleaner. Every other week to weekly, and also not on the same day you shock, add a maintenance dose of a metal and scale-sequestering product.

For most people, Saturday will be the day of pool maintenance, with the liquid products being added in the evening after people are through swimming for the day. Sunday night after the family is through swimming for the weekend is a good time to shock and add the liquid sodium bromide.

If you want to maintain the pool more economically, you may get by with doing the chlorine and pH and shock, and using the other products less often.

In addition to keeping the chemicals in proper shape in your pool, you will also need to backwash and/or clean the filter as needed, empty the skimmer and pump baskets weekly,

and empty the bag for the automatic pool cleaner, usually weekly. In heavy leaf areas you may need to empty baskets more often and dip out leaves seasonally. You should also brush the tile line and steps weekly. Once you get the hang of it, none of it is difficult or takes all that long, and doing it consistently will pay off in enjoyment of your pool and savings in maintenance costs for many years.