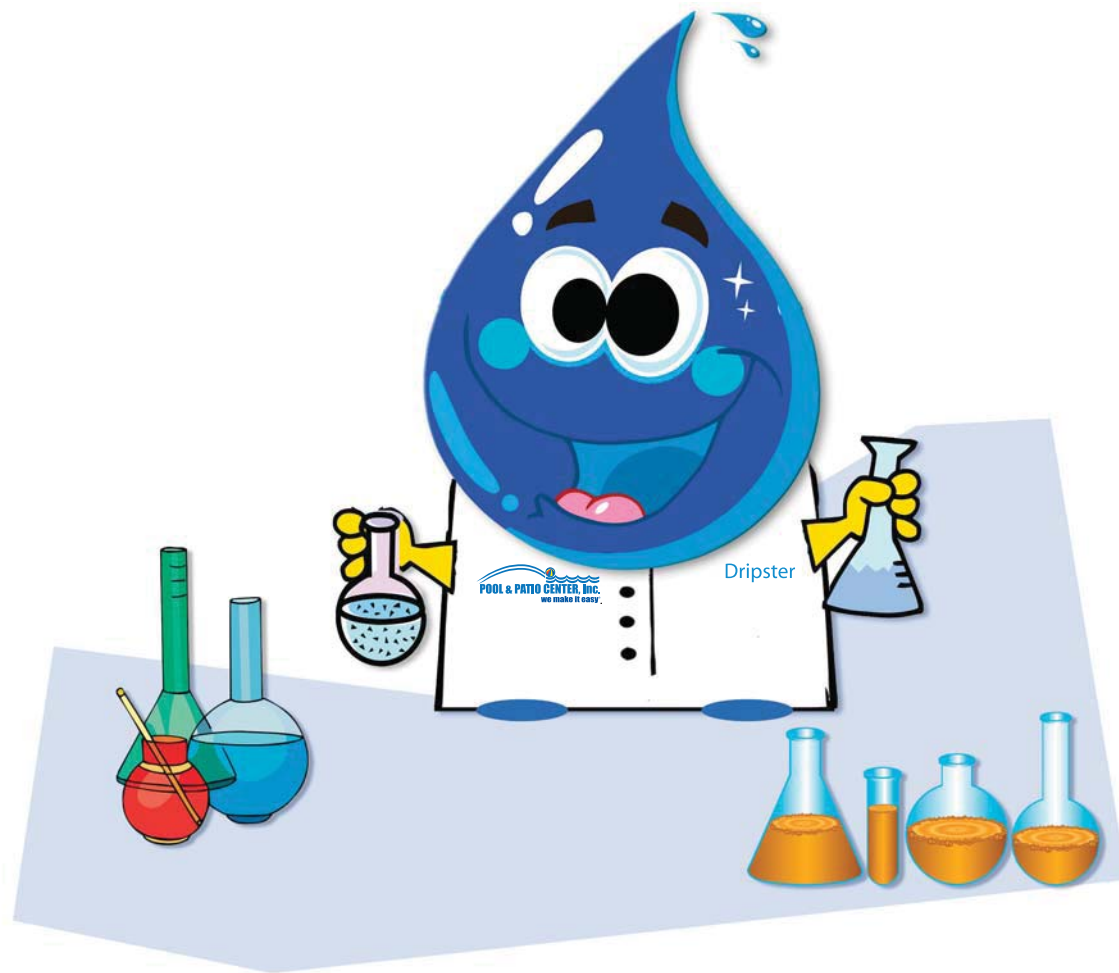


Pool Water Chemistry Made Easy




POOL & PATIO CENTER, Inc.
we make it easy[®]




POOL WATER CHEMISTRY MADE EASY

When you mention water chemistry, memories of a high school chemistry class come to mind (boring, confusing and “I’ll never use this information again”)! Well, our chemistry teachers were right—we will use this information again, especially if we own a swimming pool or spa.

There are two important factors you must keep in mind when maintaining your pool water. First, you must keep that water clean, clear and healthy to prevent waterborne illnesses so no one gets sick or gets rashes. Second, you must keep that water in a non-corrosive and non-scaling state so that the water does not damage everything it comes in contact with.

I’ll explain pool water chemistry in an easy and retainable manner. Now, don’t get that chemistry class mental block. Envision yourself floating on a lounge chair...the sun is shining...not a cloud in the sky...your toes are dangling in water...there’s a glass of iced tea at your fingertips...aaahhh...

*Annette M. Stockley
Pool & Patio Center, Inc.*






WATER CHEMISTRY FACTORS

CHLORINE: The Sanitizer

Chlorine has been in use for more than 100 years and, without it, worldwide disease pandemics would occur. Chlorine not only keeps our drinking water supplies safe but also is the most popular way to keep our pool water safe and healthy.

A properly balanced, chlorinated pool...

-  has NO offensive chlorine odor
-  does NOT burn or irritate your eyes
-  does NOT burn or irritate your nose

Chlorine performs three very important jobs:

- 1- Sanitation
- 2- Oxidation
- 3- Residual Sanitation



Debris and contaminants are constantly being introduced into your pool water from swimmers (bacteria, infections, dead skin cells, perspiration, urine, saliva, body oils along with sunscreens, lotions, cosmetics), rain (acid rain, dust, algae), wind (dust, leaves, algae) and animals (fur, bacteria & bodily waste).

Chlorine kills and oxidizes (burns away) these contaminants in order to keep your pool water CLEAN, CLEAR AND HEALTHY.

Just because your pool water is clear does not necessarily mean that it's sanitized or balanced. After all, the water in your toilet bowl is clear, but not fit for swimming.

For pool water to remain clean, clear and healthy, chlorine needs to be added to the pool water on a consistent basis to maintain a 1-3 part per million (ppm) level of chlorine every minute of every day (for every 1,000,000 'parts' of water in your pool, 1-3 'parts' should be chlorine). This process is called sanitation.









As bacteria and other contaminants are killed, visualize the chlorine attacking and then latching on to them for dear life. At this point, the chlorine has done its job and its useful life is mostly over. This 'used up' chlorine (called chloramines) rapidly accumulates in your pool water day after day. As chloramines accumulate, an awful chlorine smell develops around your pool. Chloramines are very irritating to eyes, nose and skin (they burn our eyes and nose, irritate our skin.... When this happens, most people assume there is way too much chlorine in their pool water so they stop adding chlorine. Big mistake! At this point, what your pool water really needs is an overdose of chlorine called a shock treatment (oxidation): by adding an overabundance of chlorine (and raising the chlorine level to at least 10 ppm), all this 'used up' chlorine—along with other accumulated debris—will oxidize (burn away), that awful chlorine odor will disappear and you will have some chlorine left over (a residual of chlorine called free available chlorine) to continue killing bacteria and other contaminants as they are introduced in the water (for residual sanitation).

The most important fact to remember about oxidation is that you must add enough shock to totally oxidize these contaminants out of the water (called breakpoint chlorination). If you fail to do this, the chloramines are not destroyed, resulting in an increase of chloramines which require another higher dose of shock to reach breakpoint chlorination.

*Think of shocking your pool as ‘setting fire’ to the water—
it burns (oxidizes) contaminates out of the water.*



After shocking, do not swim until the chlorine level returns to 3 ppm. When should you use a shock treatment? For general Guidelines, shock your pool. .

-  at pool opening
-  once per week
-  before heavy pool usage (such as a party)
-  after a heavy rainstorm
-  after high winds that deposit debris in pool water
-  when filter system has not run for 24 hours
-  whenever your water turns hazy, cloudy or green*
-  at pool closing

*Treating your pool water
chemistry proactively is
less expensive than
treating it reactively.*

*Your goal is to prevent your pool water from turning hazy, cloudy or green. By shocking regularly you will substantially reduce the chance of your pool turning hazy, cloudy or green.

If your pool water turns hazy, cloudy or green, follow these guidelines for shock dosages...

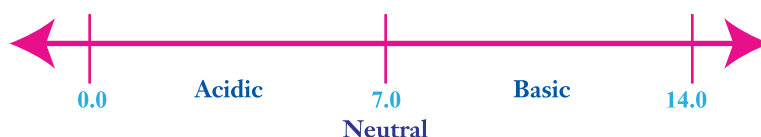
WATER CLARITY	SHOCK DOSAGES
Slight Haze	1-2 lbs. or 1-2 gals. shock per 10,000 gallons of water
Severe Haze	2-3 lbs. or 2-3 gals. shock per 10,000 gallons of water
Visible Algae	At least 3 lbs. or 3 gals. shock per 10,000 gallons of water

In conclusion, chlorine performs three very important jobs. In small doses (1-3 ppm), chlorine kills bacteria, infections and other contaminants (sanitation). In large doses (10 ppm or higher), it rids your pool water of chloramines and other debris (oxidation); and then, if you have added enough shock to reach breakpoint chlorination you will have a chlorine residual for future killing power (residual sanitation).

pH: The Measure of How Acidic or Basic Water Is

*As an example, if you add three (3) pounds of shock to
pool water which has a pH factor of 7.8, it's like adding one pound
and throwing the other two (2) pounds in the trash!*

For all you beer drinkers, did you know that the scale of pH measurement was first used in the early 1900's to measure the acidity of water in the beer brewing process? The pH scale ranges from a low of 0.0 to a high of 14.0 and is an important measurement of how acidic or basic water is.



A pH factor of 7.0 is considered neutral, a pH factor less than 7.0 is acidic and a pH factor over 7.0 is basic. For comparisons, vinegar has a pH factor of about 2.0 (very acidic) while ammonia has a pH factor of about 11.0 (very basic). Like the Richter Scale (the measurement of earthquake power), a change in each whole number of the pH scale represents a 10-fold difference. For instance, a pH of 6.0 is 10 times more acidic than a pH of 7.0.

Chlorine has a very close and direct relationship with pH. For instance, when the pH factor of your pool water is between 7.2 and 7.6, chlorine works well. When the pH factor of your pool water is below 7.2, chlorine does not stay in the water very long. In contrast, as pH rises above 7.6, chlorine becomes less effective. For example, at a pH factor of 7.8, only 33% of the chlorine in your swimming pool is working and the other 67% is considered 'inactive'.

CHLORINE'S EFFECTIVENESS AT DIFFERENT pH LEVELS	
pH Level	% of Chlorine Effectiveness
7.2	66%
7.5	48%
7.8	33%
8.0	21%

Ideal Range is 7.2 – 7.6

Now let me further explain those confusing words, acidic or basic. When the pH factor of your swimming pool is between 7.2 and 7.6, your pool water feels comfortable, remains clear and is not damaging to your pool and pool equipment (liner, filter, pump, heater, lights, etc.). When the pH factor of your pool water is below 7.2, your pool water is corrosive and acidic (like vinegar). Acidic pool water will 'eat away' at everything it touches and corrode your pool equipment quickly. Swimming in pool water that has the same pH factor as vinegar makes our skin itch and our eyes burn.

When the pH factor of your pool water is higher than 7.6, your pool water is basic and forms scale or crystals on everything it comes in contact with (think of barnacles on the bottom of a boat). High pH will not only cloud your pool water by allowing dissolved solids to come out of solution but also will leave grayish, white deposits on your pool equipment. Swimming in basic water also burns our eyes and dries our skin; in addition, it decreases filter efficiency as scale forms and causes short filter cycles (think of clogged plumbing pipes).

*To maintain clear, clean healthy water in an economical manner,
maintain your pH between 7.2 and 7.6.*

So thanks to those beer-making scientists, we can enjoy comfortable-feeling, clear, healthy pool water and a great beer—but not both at the same time!

TOTAL ALKALINITY: The pH Stabilizer

Total alkalinity is the measure of how stable the pH of your pool water is. Many individuals have a hard time keeping their pH in balance because they neglect to maintain their total alkalinity within its proper range (80-120 ppm). Think of total alkalinity as a 'buffer' for your pH— it helps keep the pH where it should be. Low total alkalinity contributes to acidic water (like vinegar) and pH 'bounce' (when the pH of your pool water rapidly fluctuates from high to low). High total alkalinity contributes to high pH, scale (think barnacles or crystals), cloudy water, dry skin and inactive chlorine. When your total alkalinity is in balance, your pH resists change.

Alkalinity is the KEY to water balance.

CALCIUM HARDNESS: The Pool Surface Protector

Next is calcium hardness. Calcium hardness is the measure of dissolved minerals found in your pool water.

When calcium hardness is in its proper range (between 180-400 ppm), our pool water has that sparkling appearance. More importantly, when our calcium hardness is in balance, your pool surface is protected (it protects vinyl liners by keeping them soft and pliable while it protects plaster pool surfaces from etching and deterioration).

Although low calcium hardness levels will never cause cloudy water, it leads to a dull appearance while high calcium hardness levels could produce cloudy, milky water. Also, low calcium hardness contributes to corrosive, acidic water while high calcium hardness forms scale and crystals on surfaces—especially when the pool water is warm.

Low pH, low total alkalinity and low calcium hardness levels will produce acidic and corrosive pool water while high pH, high total alkalinity and high calcium hardness levels will produce cloudy, scaling pool water.

CYANURIC ACID: The Chlorine Stabilizer

Cyanuric acid (chlorine stabilizer) is a substance that protects chlorine from the sun. Since sunlight quickly depletes and destroys chlorine levels in pool water, cyanuric acid helps chlorine stay in your pool water longer. As an example, on a bright sunny day 3 ppm of chlorine will last about two hours in your pool water if no chlorine stabilizer is present. Maintaining your cyanuric acid level within its proper range (30-80 ppm) and maintaining your chlorine level between 1-3 ppm will ensure that your pool water stays clean, clear and healthy for longer periods of time.

Think of cyanuric acid as a sunshield, sunscreen or insurance policy.

Always check with us before routinely adding cyanuric acid to your pool water because some types of chlorine have cyanuric acid built right into them.

Balanced pool water prolongs the life of your pool surfaces and equipment while ensuring healthy, safe swimming.

METALS

As for iron, copper or any other metal, we strive to maintain a 0 ppm level. When high metal levels are present your pool water may appear colored (green, red, brown or black) and the potential for staining pool surfaces is greater.

How do metal stains occur? Well, there is some metal in all water sources but water that originates from a well typically contains more metals. In addition, corrosive and acidic water allows metal to come out of solution, just like too much sugar in a cup of coffee will not fully dissolve. When metals come out of solution, they deposit on pool surfaces and cause staining. Metal stains can also occur during shock treatments if a high metal level is present beforehand.

Also, corrosive and acidic water attacks and ‘eats away’ at metal objects (lights, hardware, ladders, copper heating elements, etc.) introducing more metal into your pool water. In addition, sometimes we inadvertently add metal to our pool water by overdosing on algaecides that contain metal. Metal based algaecides are very concentrated and should only be added to **BALANCED** pool water in the recommended measured dose for your pool size. When it comes to metal algaecides, more is not better!

What is the moral of the metal story? To prevent or minimize metal stains, maintain water balance and do not overdose on metal algaecides.

Metal Stains








WATER STAIN OR COLOR	METAL TYPE
Greenish Blue, Blue or Gray-Black	Copper
Green, Yellow or Reddish-Brown	Iron
Tan, Purple or Black-Gray	Manganese
Gray, Grayish White	Oxidized Metals or Scale

TDS: Total Dissolved Solids

TDS, or total dissolved solids, is the sum of all dissolved material (minerals, metals, salt, organic matter) from all the products you have added along with the sum of dissolved material that was included in your fill water. We strive to maintain a TDS level of less than 1500 ppm. At a high TDS level your water becomes hard to manage, your filter operates poorly and your water becomes cloudy. Fortunately for us in New England this is not a common problem since we lower our water level every autumn. When we lower our water level at pool closing and refill in the spring, we are diluting our TDS levels.

So, let us think of chlorine, pH and total alkalinity as dominos—each one affects the other. Proper total alkalinity helps keep our pH in range, proper pH enables the chlorine to work well and chlorine keeps our pool water clear, clean and healthy. If one is out of balance, the ‘dominoes’ start to fall.

When Is The Best Time To Test Your Pool Water

-  after adding make-up water at spring opening (filter for at least 8 hours to mix the old water with the new water)
-  after pool water has circulated for at least 8 hours during any other time of year
-  after taking sample from at least 18-inches below the water surface and away from the skimmer and filter returns
-  when chlorine level is below 5 ppm
-  before adding a shock treatment
-  before adding water chemistry products
-  as soon as it is removed from your pool (water chemistry begins to deteriorate immediately)

How To Add Water Chemistry Products To Your Pool Water Chart

Product	How to Add
Liquid Shock	Pour around pool perimeter.
Granular Shock	Dissolve a little bit at a time in bucket of water and pour around pool perimeter. NEVER ADD WATER TO CHEMICALS, EXPLOSION MAY OCCUR; ADD CHEMICALS TO WATER.
pH Plus	Broadcast over pool surface and brush, if needed.
pH Minus	Dissolve in a bucket of water before adding.
Total Alkalinity	Broadcast over pool surface and brush, if needed.
Calcium	Broadcast over pool surface and brush, if needed.
Chlorine Stabilizer	Broadcast over pool surface and brush, if needed; add when water is clear; do not vacuum and then backwash for 7-10 days after adding.

FILTRATION & CIRCULATION

*Proper Circulation + Proper Filtration + Balanced Water Chemistry =
Clean, Clear Healthy Pool Water*

- 💧 Circulation and filtration are vital and necessary for maintaining clean, clear healthy water. No matter how conscientious you are about adding water chemistry products, they will **NOT** perform unless there is proper circulation and adequate filtration. If you are having a hard time clearing your pool water, check the operation and cleanliness of your filter system.
- 💧 For optimum filtration, start with a **CLEAN FILTER**. If your filter is dirty, you'll be adding sanitizing and water balance products until the cows come home—and your pool water still will not clear.
- 💧 DE or Cartridge Filters: Chemically clean fingers, grids or cartridges once or twice per year to remove deeply embedded debris and oils. Remember—rinsing is **NOT** the same as chemically cleaning them.
- 💧 Sand Filters: Replace sand yearly for above ground pools and every 3-5 years for inground pools.
- 💧 Besides keeping your filter chemically cleaned, you must periodically backwash your sand filter, replenish the DE in your earth/DE filter or rinse off your cartridge filter whenever the water returning to the pool becomes sluggish.
- 💧 Moving water (circulation) ensures even distribution of your water chemistry products and helps 'dead spots' (where water does not circulate well—such as behind steps or ladders or in corners).
- 💧 Proper circulation occurs when your water return jets are pointed downward at a 45-degree angle turned away from the skimmer.
- 💧 Proper filtration is accomplished when you run your filter system for 8-12 hours **EVERY** day. **IF YOUR POOL WATER IS CLOUDY OR GREEN, YOU MUST RUN YOUR FILTER SYSTEM CONTINUOUSLY—24 HOURS PER DAY—UNTIL YOUR POOL WATER CLEARS.** As soon as you turn off your filter system, the cleaning process **STOPS!**
- 💧 Moving water makes it hard for algae to cling to pool surfaces and, subsequently, flourish. Algae grows in layers. When you brush an algae-infested surface you are removing the top layer and exposing the bottom layer to chlorine and algaecide. For this reason, you must brush your pool surfaces repeatedly—**NOT** just once—when you have an algae infestation.
- 💧 Weekly brushing of your pool walls, floor and water line removes and disturbs that slimy film (the same type of slimy film that develops in a pet water dish or bird bath when we don't wash it out). Brushing also helps compensate for the 'dead spots' in your pool.

ALGAE

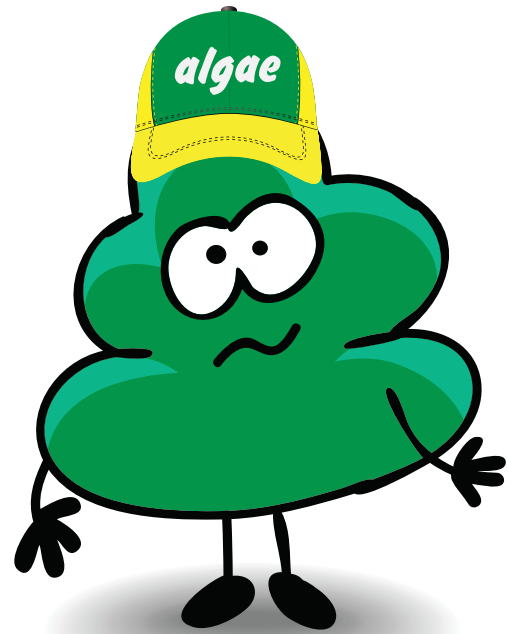
Algae in and of itself is not harmful—remember swimming in the pond as a child? Ponds and algae go hand-in-hand. Nevertheless, swimming in an algae-infested pool is not recommended because...

- 💧 Slippery pool surfaces are hazardous.
- 💧 Algae and bacterial growth are related. Algae have been allowed to flourish in your pool water as a result of poor maintenance (poor sanitation, oxidation, filtration and circulation practices).
- 💧 Algae can frequently make pool water so cloudy you cannot see under the water surface. Never, ever swim if your pool water is so cloudy that you cannot see a swimmer when they are under the water surface.

Theoretically, algae cannot take hold as long as you properly filter and circulate your pool water, maintain a proper chlorine level **every** minute of **every** day and sufficiently shock on aregular basis. If you use liquid chlorine or chlorine tabs you may frequently develop an algae bloom because liquid chlorine is very unstable (dissipates quickly) and chlorine tabs dissolve too slowly to keep up with the sanitation demands put on pool water. Using a maintenance dose of algaecide protects your water from algae formation when the chlorine level has dipped too low. Always check with us before automatically adding algaecide because some weekly sanitizer systems have algaecide built right into them.

Here are some factors that contribute to algae growth...

- 💧 Warm water
- 💧 Sunlight
- 💧 High pH level
- 💧 Low free available chlorine level
- 💧 Poor filtration
- 💧 Poor circulation
- 💧 Short filter cycles
- 💧 High bather load
- 💧 High total dissolved solids (TDS) level



CLOUDY & COLORED WATER

- 💧 is not inviting
- 💧 is an indication that something is wrong with your water chemistry, filtration and/or circulation
- 💧 may contain contaminants that may make you sick
- 💧 cause slippery pool surfaces

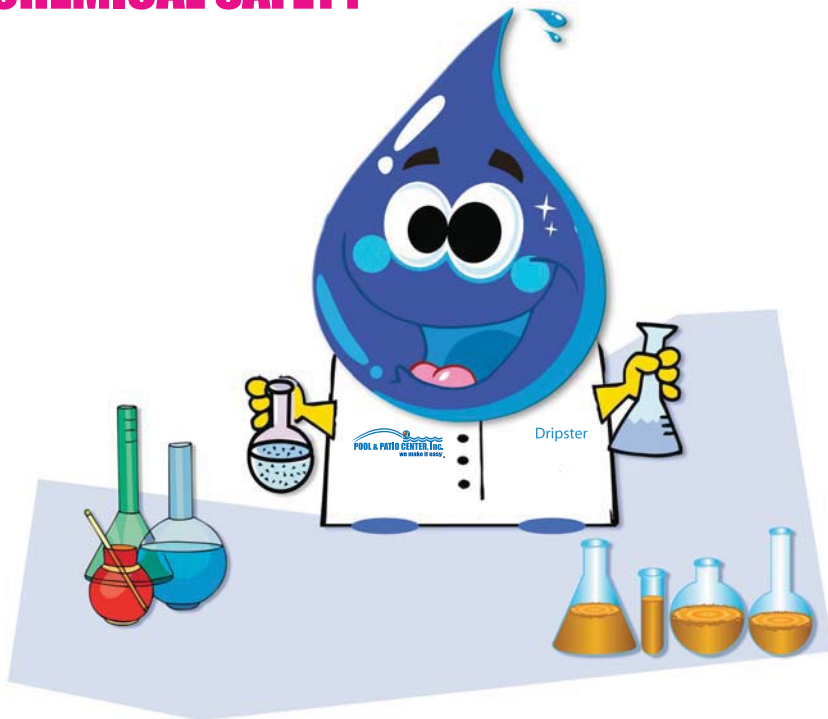
Never swim when your pool water is not clear as you may not be able to see someone under the water surface because of poor visibility.

MISCELLANEOUS

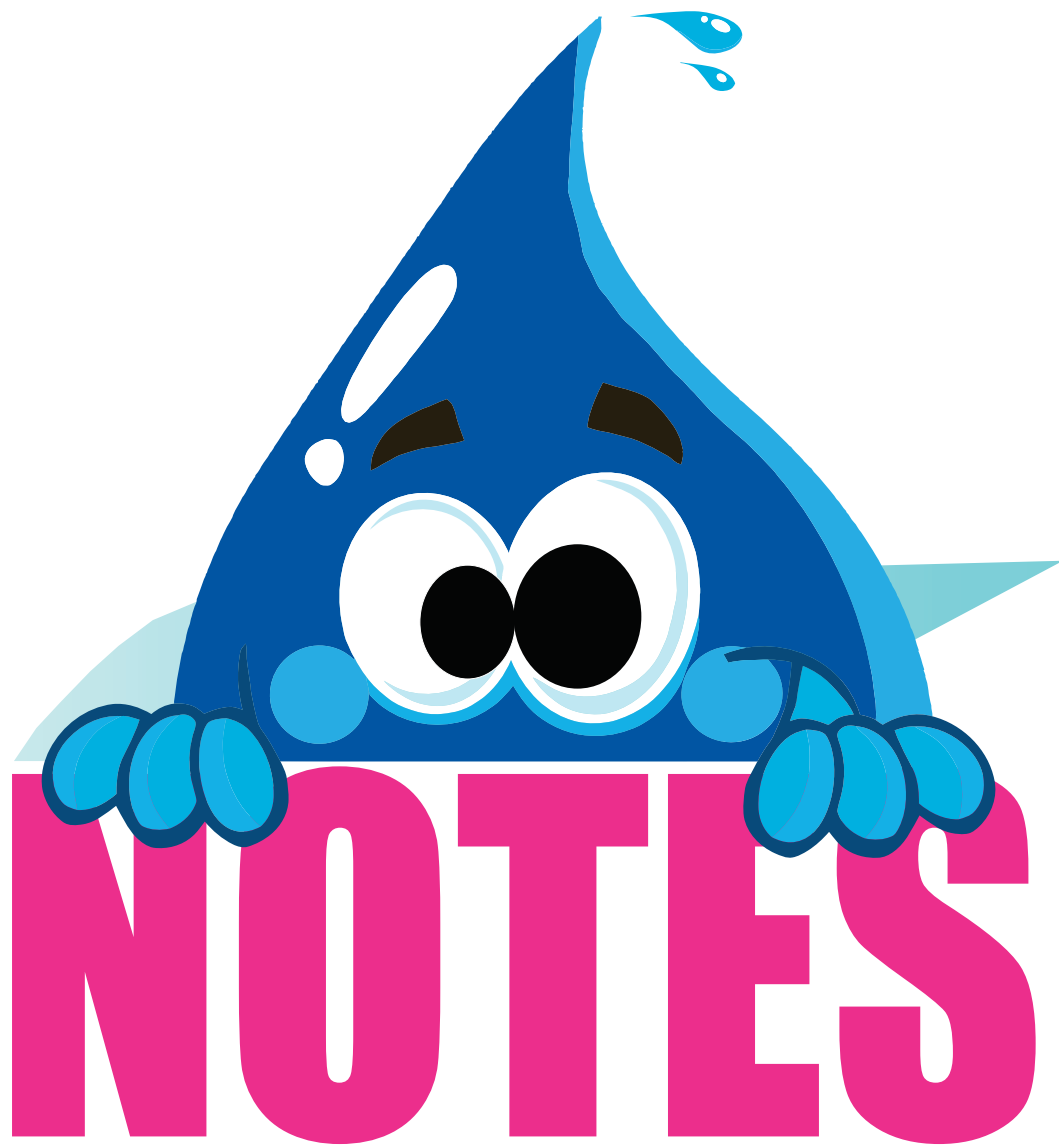
- 💧 When opening your pool, maintain a very high chlorine level until the water is clear. Depending upon the condition of your water, you may need to shock EVERY DAY for two or more days in a row. There is a high demand for chlorine until your water is clear.
- 💧 Every type of chlorine has advantages and disadvantages. As a general rule of thumb, the least expensive types of chlorine require the most maintenance. Each type of chlorine has a different pH factor and each type of chlorine is added to the pool water at different frequencies (twice a day, every day, twice per week or once per week). Some types of chlorine have an extremely low pH factor (chlorine tabs have a pH factor of about 3.0) while other types of chlorine have a high pH factor (liquid and calcium-based chlorine have a pH factor of about 12.0). As they are dissolved in your pool water they continually play havoc with your pH level and water chemistry.
- 💧 Pay special attention to the percentage of active ingredients in water chemistry products. Some products are VERY concentrated—a little goes a long way and more is not necessarily better. As an example, the gallon-type algaecide prevents algae while most quart-type algaecides prevent AND kill algae.
- 💧 Always add water chemistry products with the filter running—unless recommended by us.
- 💧 Measure—don't estimate product dosages.
- 💧 Water clarifiers are recommended for pools with large amounts of algae or debris. A clarifier will speed up the process of clearing your pool water, especially when used with a sand filter. Clarifiers will collect small particles and clump them together to form larger particles. Larger particles are easily filtered out of pool water.
- 💧 Brushing the walls and floor of your pool should be part of your weekly maintenance schedule, especially during periods of light pool usage. If you've ever had a pet and changed their drinking water without periodically washing out the bowl (using friction), you noticed a layer of slime (biofilm) build up on the bowl surfaces. Well, the same process happens if we fail to brush our pool walls and floor.

- It's unfortunate that most individuals blame chlorine for eye irritation when the culprit is actually chloramines or out-of-range pH. Since the pH factor of our eyes is about 7.5, it's no surprise that pool water with a lower or higher pH factor will be irritating.
- Periodically bring us a water sample for testing (at pool opening, about once every four weeks, at pool closing or whenever you are having a hard time clearing your pool water).

CHEMICAL SAFETY



- Never mix different forms of chlorine together.
- NEVER ADD WATER TO CHEMICALS—EXPLOSION MAY OCCUR.** Always add the chemicals to water.
- NEVER MIX CHEMICALS TOGETHER.** Always add chemicals separately, always add them directly to the pool water and always follow manufacturer's directions.
- NEVER ALLOW CHILDREN TO HANDLE CHEMICALS--**keep chemicals out of children's reach.
- Never add chlorine to the skimmer if you have another type of chlorine in the skimmer, if you have an automatic chlorinator or if you have a salt chlorine generator—**EXPLOSION MAY OCCUR.**
- The best way to dispense slow-dissolve chlorine tabs is in an automatic chlorinator.
- Never store chemicals near open flames or flammable material.
- Never store dry chemicals next to liquid chemicals.
- Never allow chemicals to remain in your car trunk or unventilated area. Remove and store them in an outdoor shed.
- Always circulate the chemicals before swimming.
- Always dispose of empty chemical containers properly--never reuse containers.
- Always follow manufacturer's directions when using chemicals. Leftover chemicals should always be disposed of according to manufacturer's directions.





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