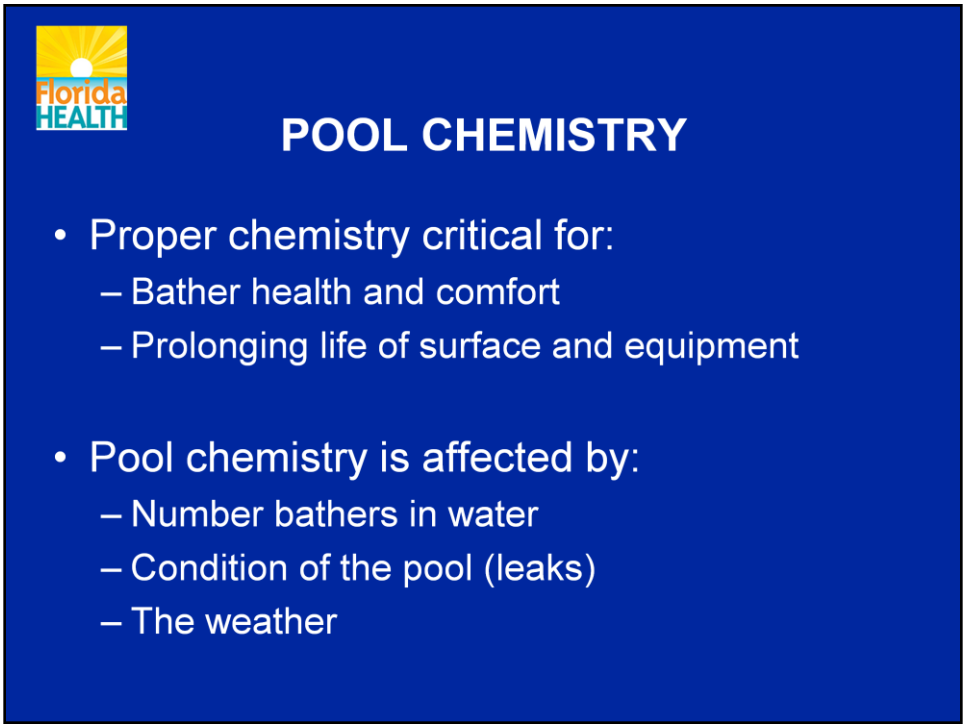
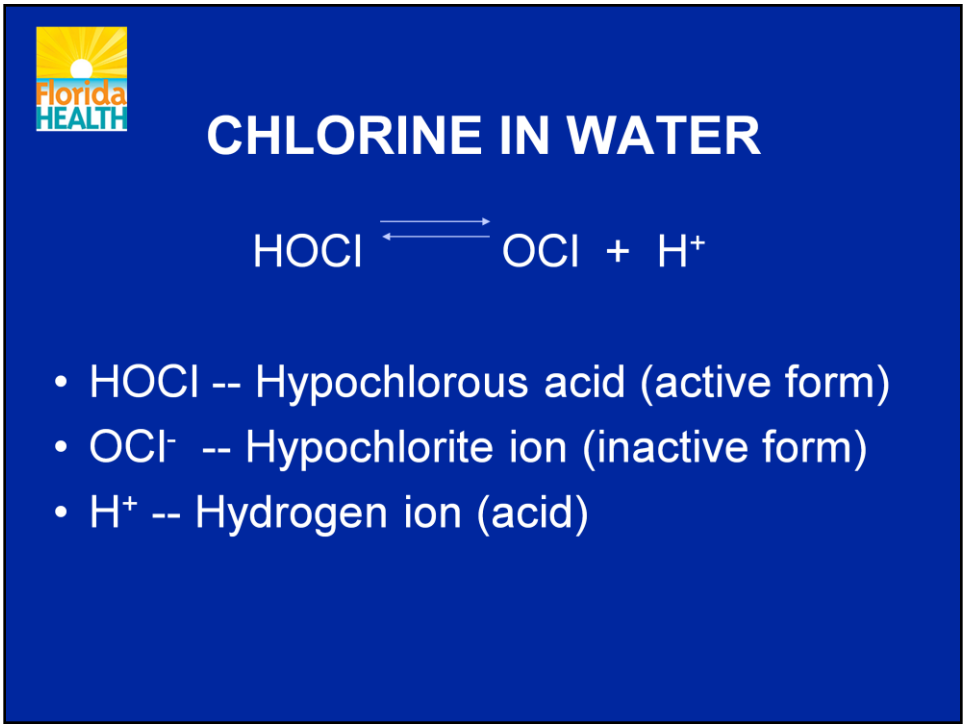
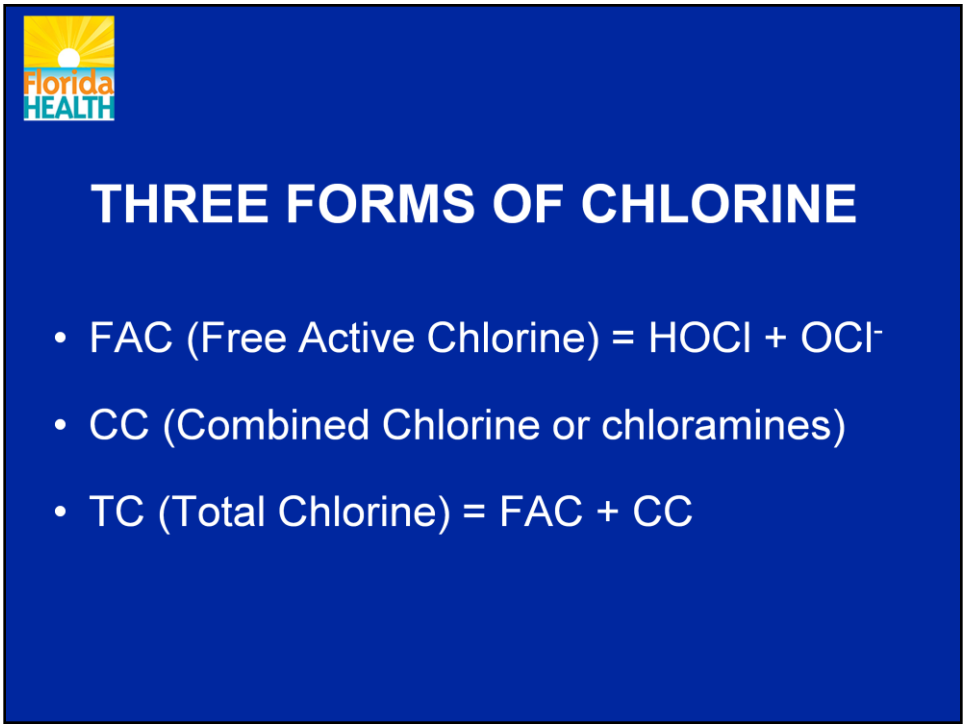
Understanding basic pool chemistry is one of the most important factors in pool maintenance. Properly balanced water creates an environment that optimizes the disinfection process and protects the pool system components from chemical corrosion. It increases the operating life of the equipment.



Maintaining good chemistry is important for several reasons, like bather health and comfort, and prolonging the life of the pool surface and equipment. The chemistry can also be affected by certain things, like the number of bathers in the water, the condition of the pool and whether it has any leaks or malfunctions, and the weather. You should also consider the nature of the bathers, if a lot of kids swim or the pool is regularly busy, take that into consideration. And remember that the surrounding landscape, wildlife and the source water of the pool can all affect the chemistry.

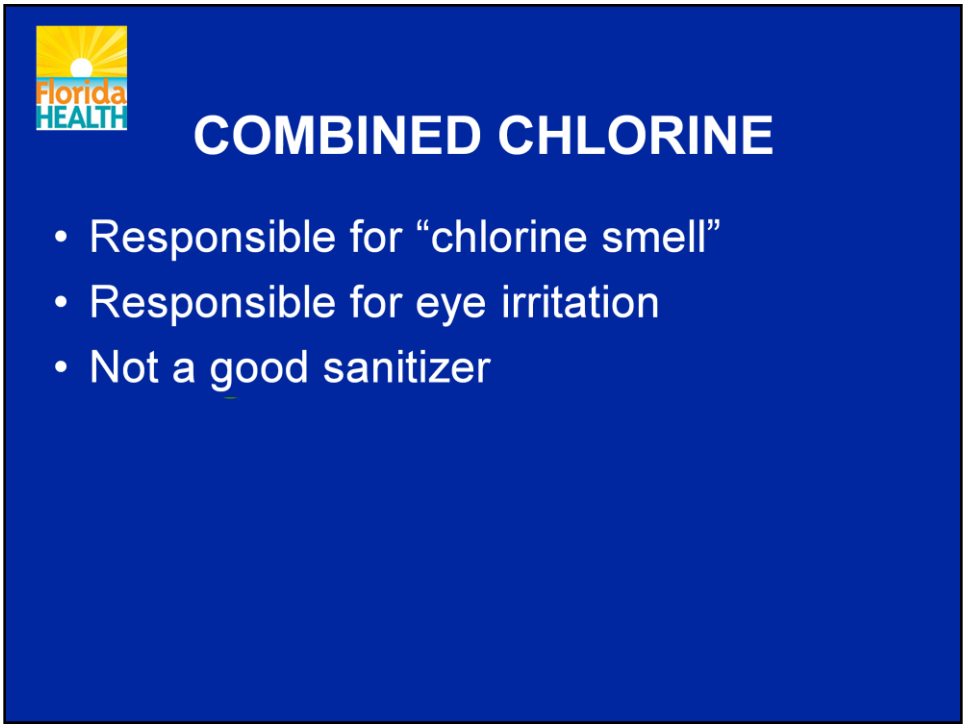


. When chlorine is added to the water it produces hypochlorus acid. This is the active form of chlorine and does all the work. Also produced are the hypochlorite ion, which is the inactive form of chlorine, hydrogen ion, an acid, and other byproducts specific to the type of chlorine being used in the pool.



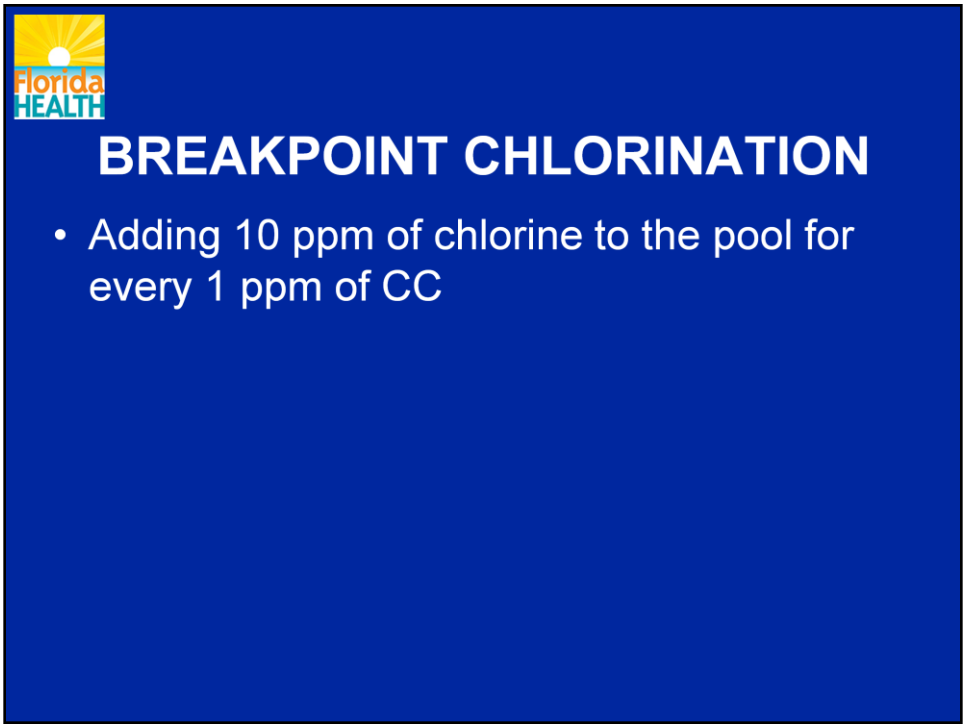
There are three types of chlorine we can measure with our test kits: Free active, combined and total. Free active chlorine is what our test kit measures in shades of red. It is the active disinfectant in the water; free active chlorine is the only type we want in our water. The next is combined chlorine, also known as chloramines.

This is present when the free chlorine attaches to nitrogen compounds like sweat and urine. Combined chlorine is tired chlorine, and is no good for disinfecting. Last is total chlorine, which is the sum of free chlorine and combined chlorine. Our test kits measure free active and total chlorine. To calculate our combined chlorine we use subtraction.



Combined chlorine forms when free active chlorine reacts with ammonia or organic nitrogen compounds in the water. In a pool these come from urine, sweat and the environment. You don’t want combined chlorine in a pool, it stinks and burns the eyes.

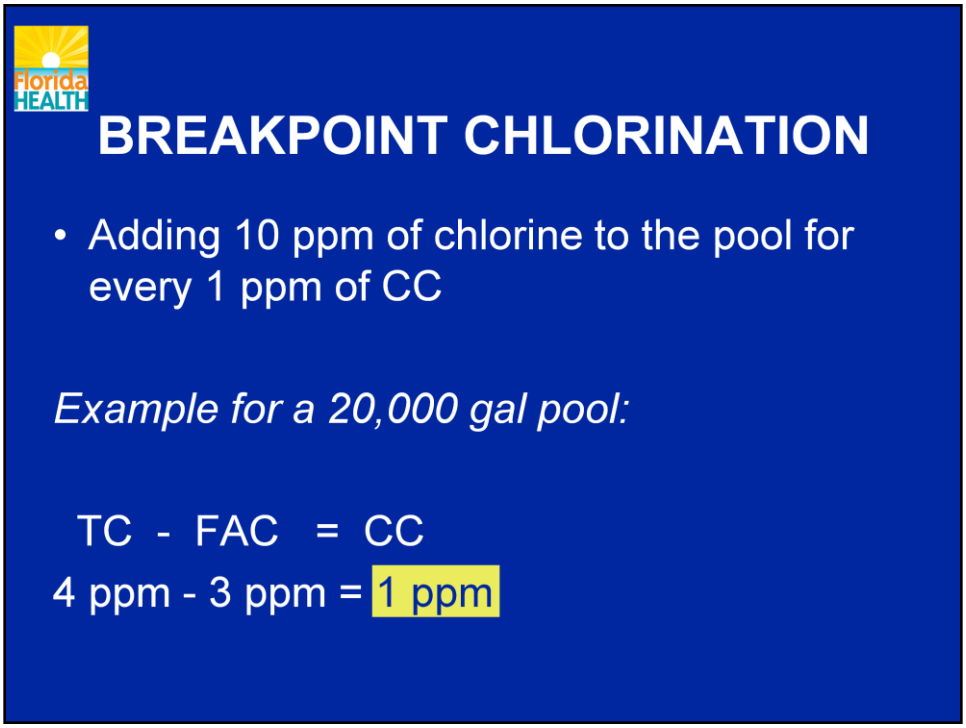
When people complain of the “chlorine smell” in a pool it’s usually because there’s not enough free active chlorine and they are smelling the used up combined chlorine. To get rid of the combined chlorine, we have to use breakpoint chlorination, also known as shocking the pool with fresh chlorine.



. Breakpoint chlorination is a shocking treatment where 10ppm of new chlorine is added for every 1ppm of combined chlorine that's present.

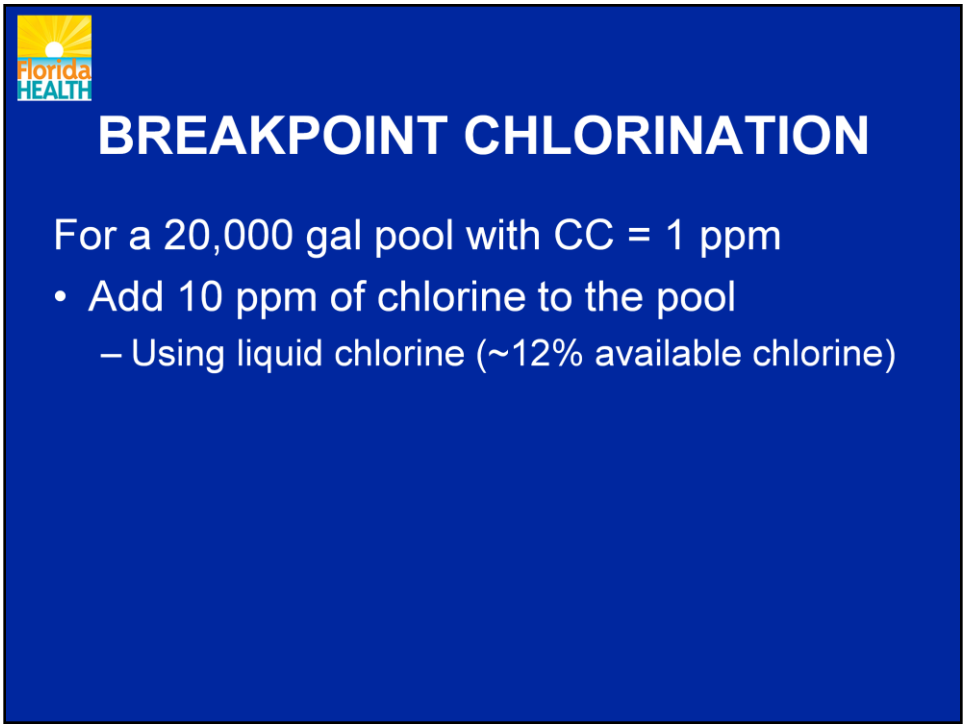
First you measure your combined chlorine present with all three bottles in your test kit for chlorine.

Perform the standard test using #1 and #2 to get the red color, let's say it reads 3 ppm of free active chlorine, then add drops from bottle #3 and read it again, if it is darker then you have a total chlorine reading that is different than your free active chlorine reading.

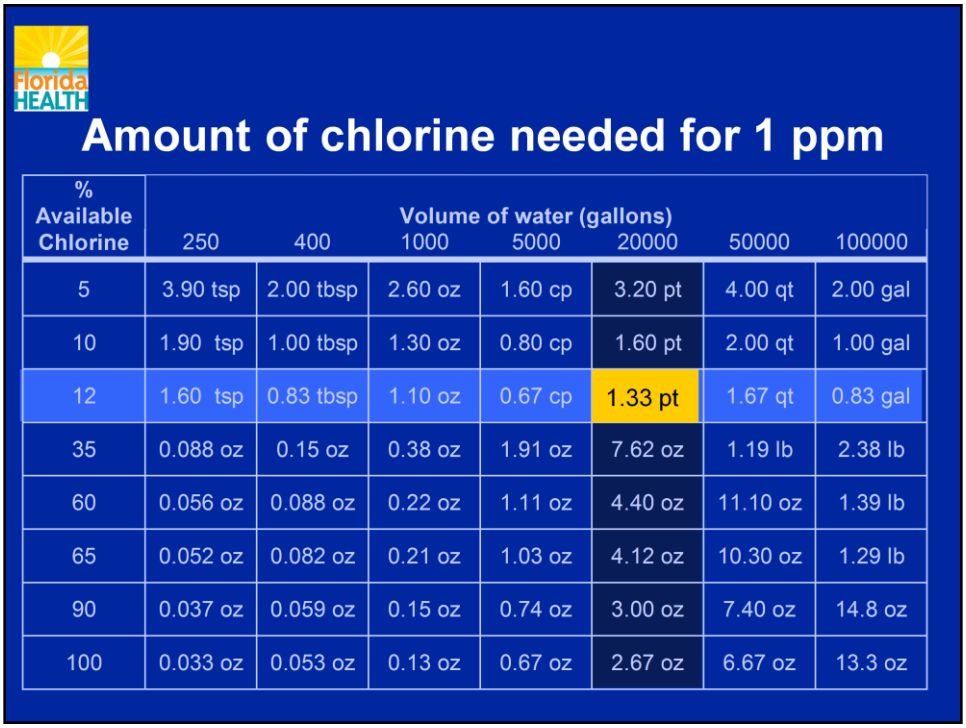


For breakpoint chlorination you must add 10ppm of free active chlorine for every 1ppm you have of combined chlorine.

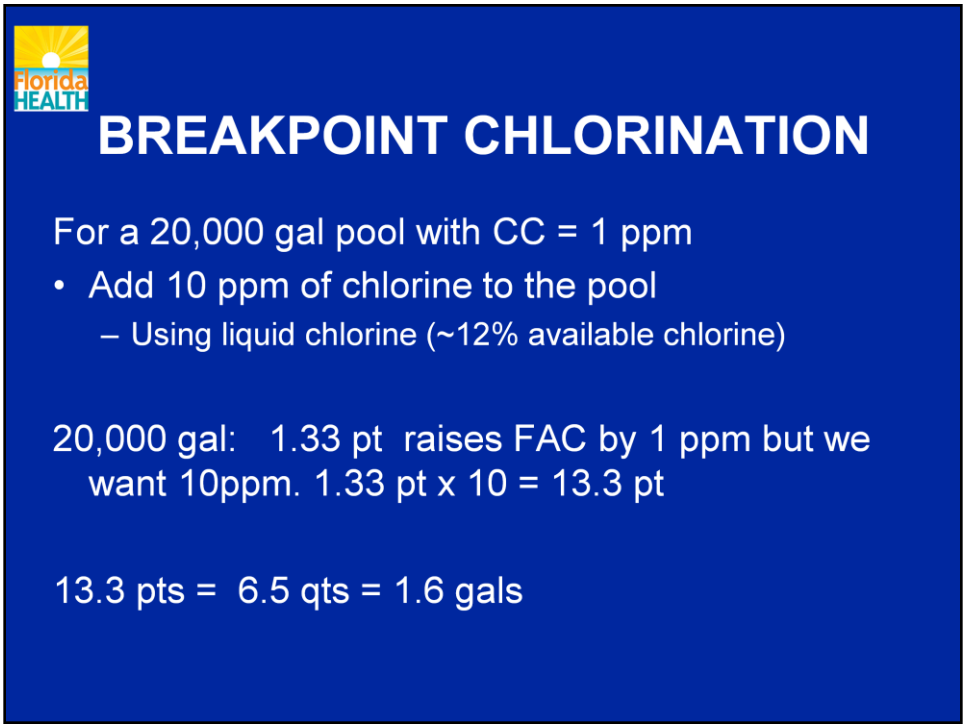
In this example we have for a 20,000 gal pool you subtract the total chlorine from the free active chlorine, which gives you a combined chlorine count if there's 3ppm of free active chlorine, and after adding the #3 drops and found the total chlorine is 4ppm, you subtract the free active from the total chlorine to determine that there is a combined chlorine count of 1ppm.



Since we have a combined chlorine count of 1ppm, we need to add 10ppm of new chlorine to the pool to get rid of the combined. This example uses 12% sodium hypo, or liquid chlorine that usually comes in yellow jugs.

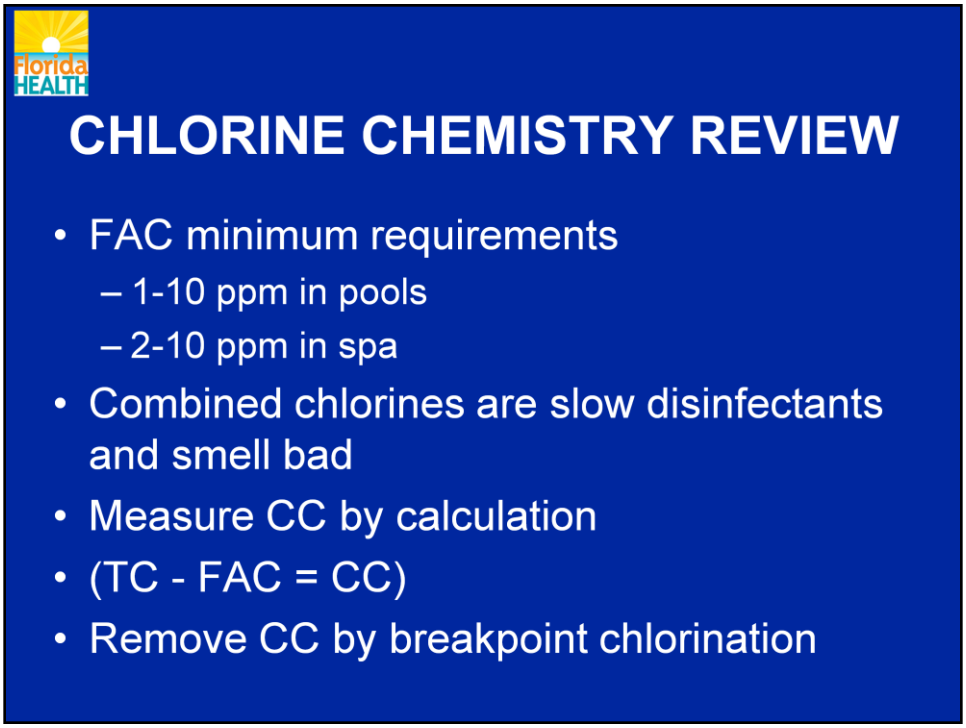


. Looking at this chart, you find the chlorine you're using, and here it's 12% sodium hypo then you find the volume of the pool in question, which is 20,000 gallons so you can determine that you need 1.33 pints of new chlorine to raise the pool 1ppm (but it needs to be raised 10ppm).

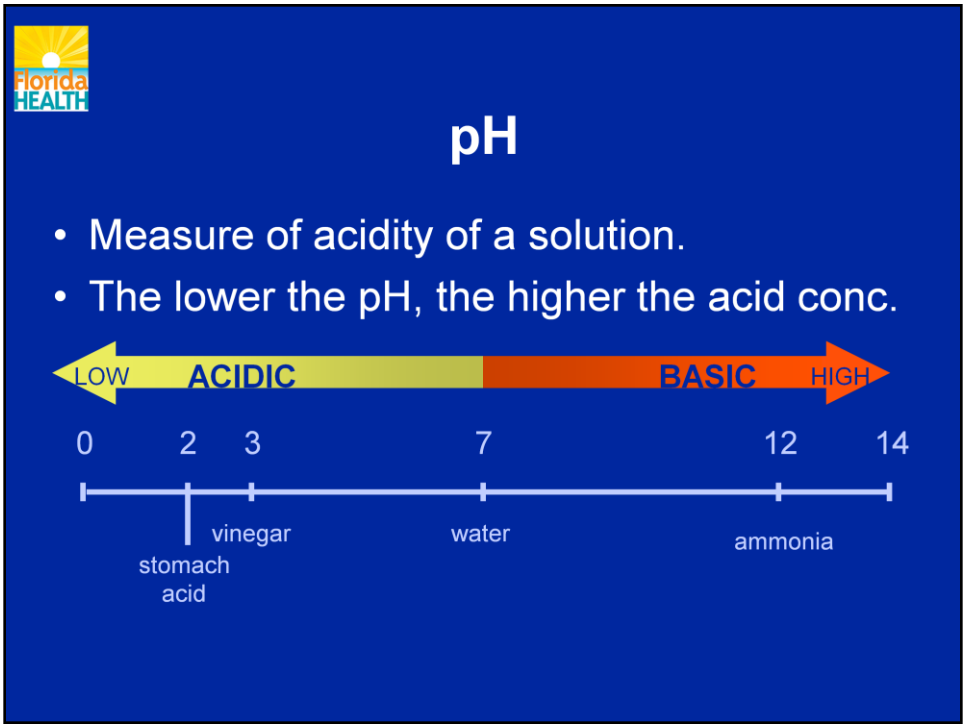


We take 1.33 pints and times it by 10 to get 13.3 pints. Since liquid chlorine comes in gallon jugs, you have to continue converting.

13.3 pints equals 6.5 quarts which equals 1.6 gallons. So you need a little more than 1 ½ gallons of fresh chlorine to burn up the combined chlorine.

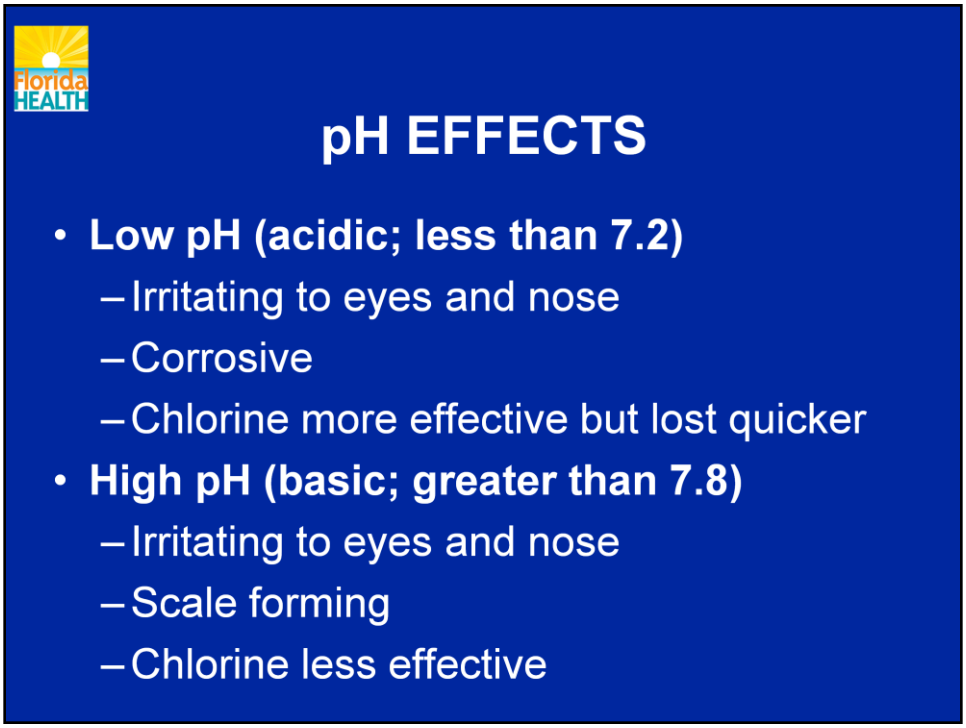


Chlorine chemistry review… The free active chlorine requirements are 1-10ppm in pools and 2-10ppm in spas; combined chlorines are slow disinfectants and smell bad. This is responsible for the “chlorine smell” in water. You can measure combined chlorine by the calculation total chlorine minus free active chlorine which equals combined chlorine and you remove combined chlorine using breakpoint chlorination.



pH stands for potens hydrogen, and is the measure of the acidity of a solution. The concentration of hydrogen is what measures pH in the water. The lower the pH of something is, the higher the acid concentration will be.

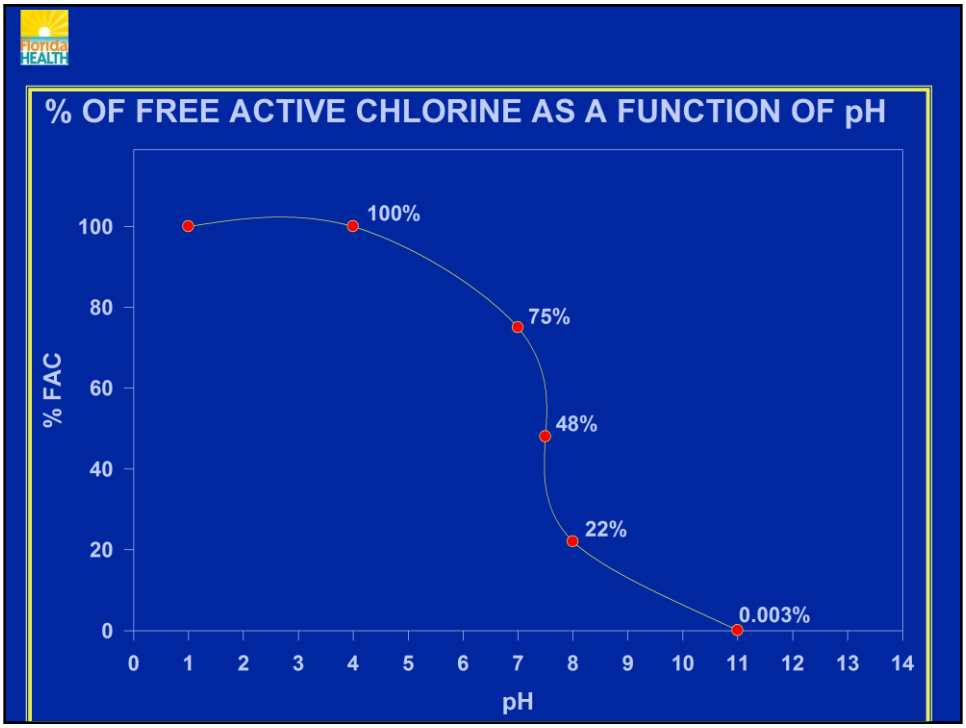
This scale shows where certain liquids fall and the arrows indicate whether it's acidic or basic. Our bodies fall in the 7.4 – 7.6 range, which is an ideal place for the pH of the water to be also. The requirements for pH levels are between 7.2 and 7.8. If it's too low it's acidic, there's too much acid in the water. A high pH is basic, and needs some acid.



As a water balance factor, pH has the most impact on properly balanced water and the comfort of swimmers.

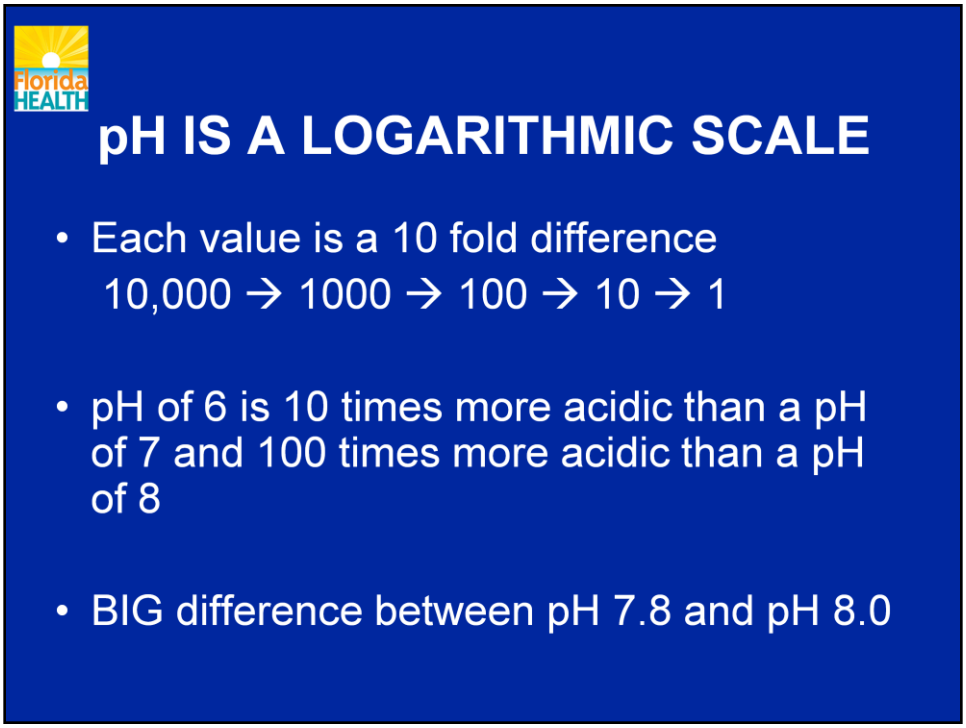
Low pH can cause corrosion of metals and stain surface walls, and the chlorine in the pool is more effective but lost quicker.

A high pH can clog filters and heater elements, reduce the circulation and cloud the water. It can also lessen the effect of your chlorine. Both a high and a low pH can affect swimmers, creating irritation of the eyes and nose.



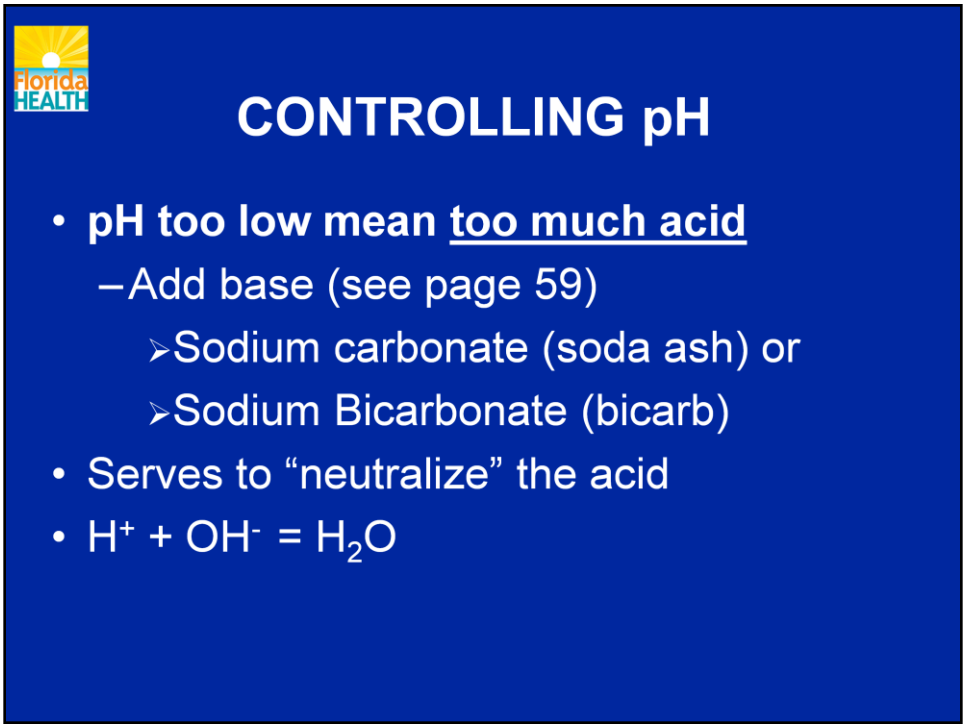
This chart shows the importance of keeping your water balanced. A pH of 4 has 100% of the chlorine in the pool working, but it's also created health hazard because it's too much chlorine.

A pH of 7.5 has 48% of the chlorine working, which is a good place to be because you have a balanced pool. As you can see on this chart the more the pH goes up, the less effective your chlorine becomes.

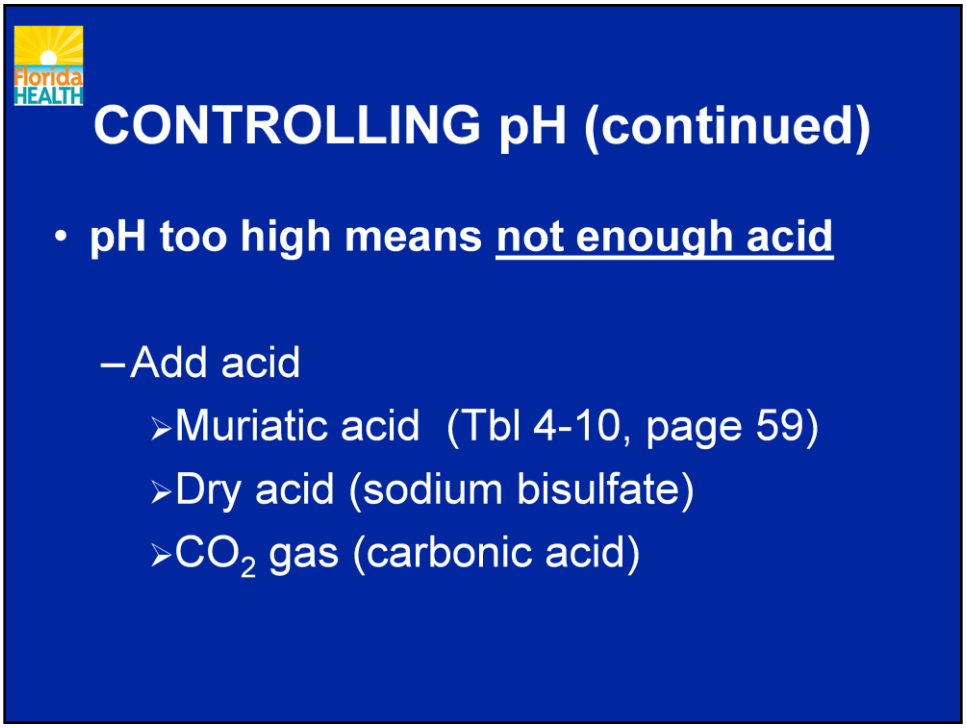


pH works on a logarithmic scale, where each value is a ten-fold difference.

This means that a pH of 6 is ten times more acidic than a pH of 7 and 100 times more acidic than a pH of 8. A small change in pH actually represents a large change in acidity.

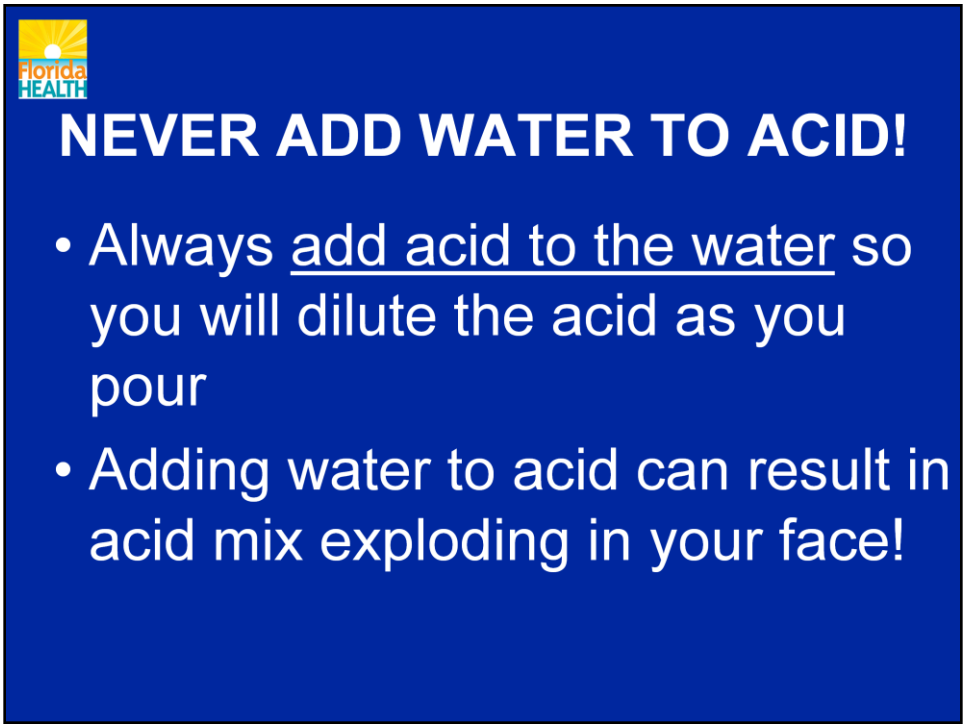


A low pH is too acidic, so you need to add a base like sodium carbonate, also known as soda ash, or sodium bicarbonate. This serves to neutralize the acid in the water. If you are adjusting for a low pH you should check the alkalinity also because too much acid will eat up your alkalinity as well as lower the pH.



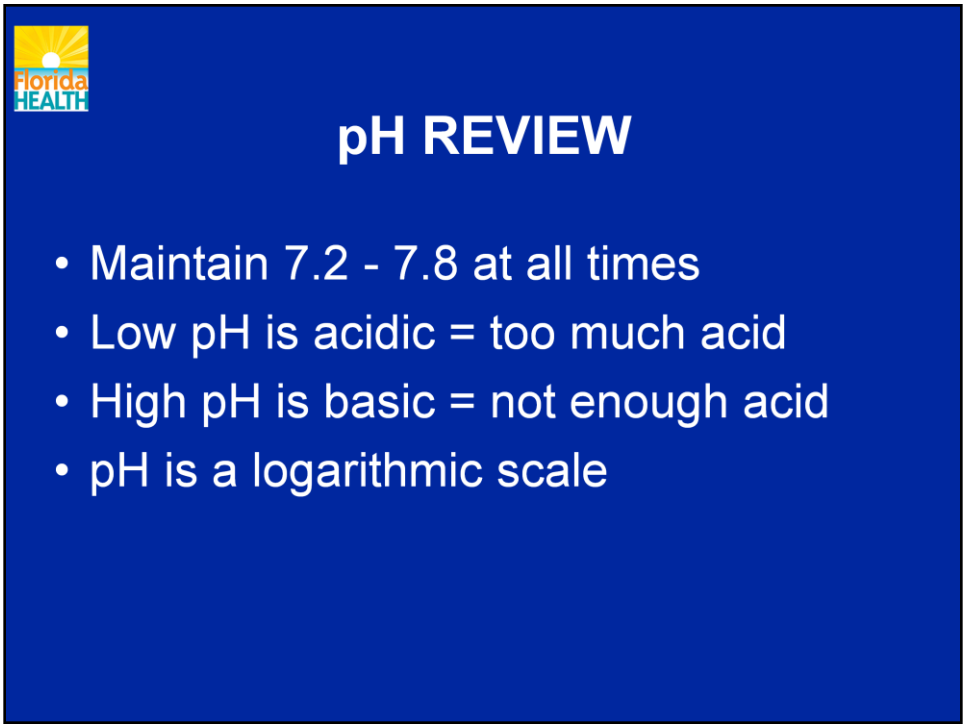
A high pH is too basic, it needs acid. You can add muriatic acid, which is the most common, or dry acid. If you use sodium hypo you need acid feeders since the sodium hypo has a pH of 12-13.

Acids and bases can be added directly into the pool, but there must be no bathers present and the pool must stay closed for an hour.



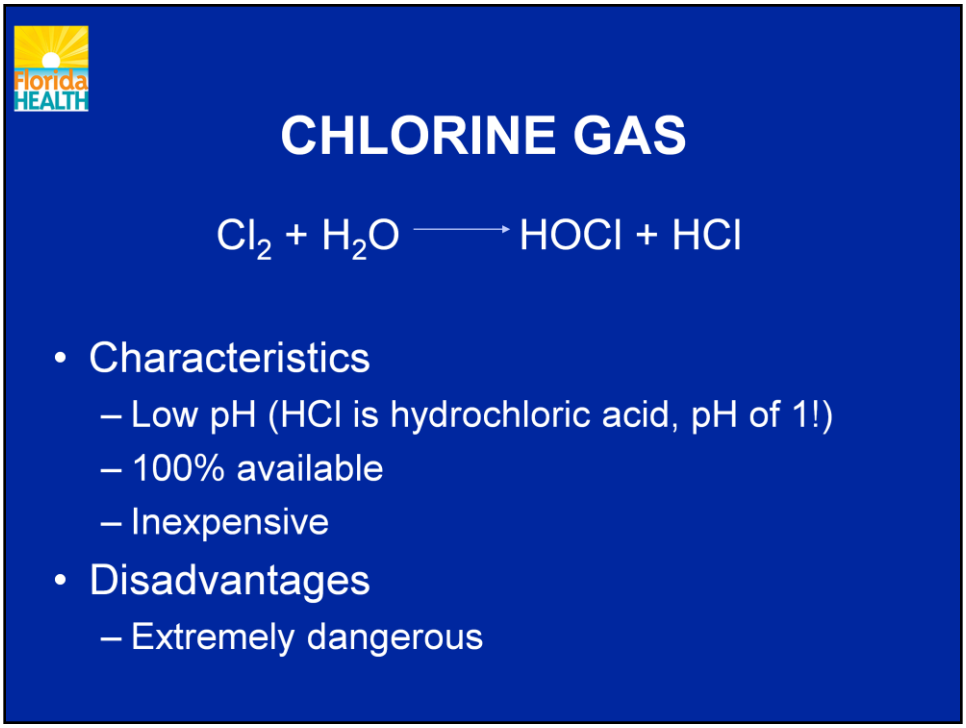
Always add acid to the water so you will dilute the acid as you pour. Adding water to the acid can result in an acid mix exploding in your face.

It’s also important to keep your containers labeled properly. Putting the wrong chemicals in your containers can create some dangerous fumes.



pH review –

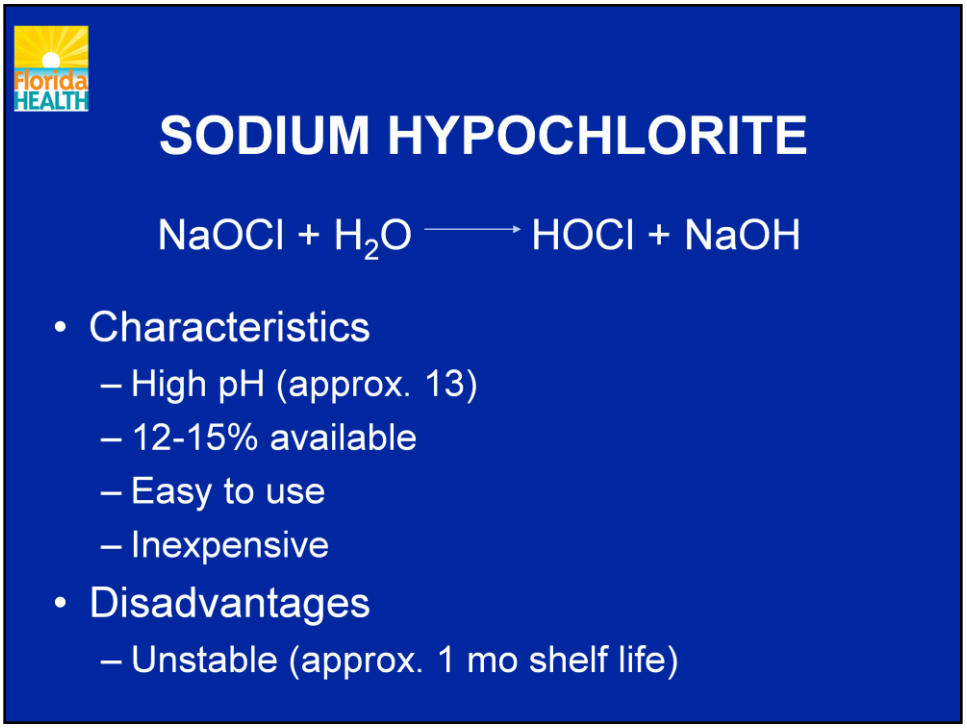
1. Maintain a pH of 7.2 to 7.8 at all times.
2. A low pH is acidic, there's **too much** acid.
3. A high pH is basic, there's **not enough acid**
4. Remember that pH is on a logarithmic scale.



. There are other types of chemicals that you can use, such as chlorine gas. Some characteristics of chlorine gas are that it has a low pH, it's 100% available chlorine and is inexpensive. The downside is that it can be very dangerous to use.

Chlorine gas is very effective, but the cost to maintain the equipment plus the extra insurance costs make it mostly unused. A by-product of chlorine gas is hydrochloric acid, and if you inhale chlorine gas it will make contact with the water in your lungs, turn to hydrochloric acid and melt the lung tissue because it has a pH of 1.

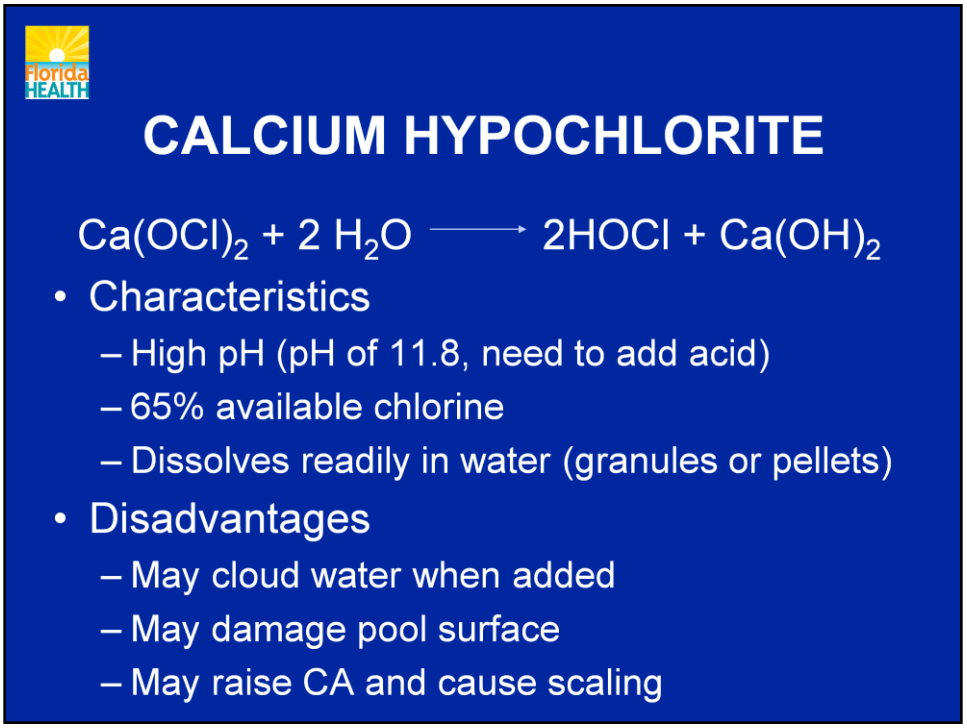
By comparison muriatic acid has a pH of zero, so you can understand the danger of chlorine gas inhalation.



Sodium hypochlorite is the most commonly used disinfectant in pools. This is the yellow jug that you typically see for chlorine.

Some characteristics of sodium hypo are a high pH, around 13; it has 12-15% available chlorine, and it's easy to use and inexpensive.

A disadvantage is that it is unstable and can lose its strength. It has a shelf life of approximately 1 month.



Calcium hypochlorite is a dry form of chlorine that comes in granules and pellets. These are used in erosion feeders. Some characteristics are it has a high pH, it has 65% available chlorine, and it can dissolve readily in water.

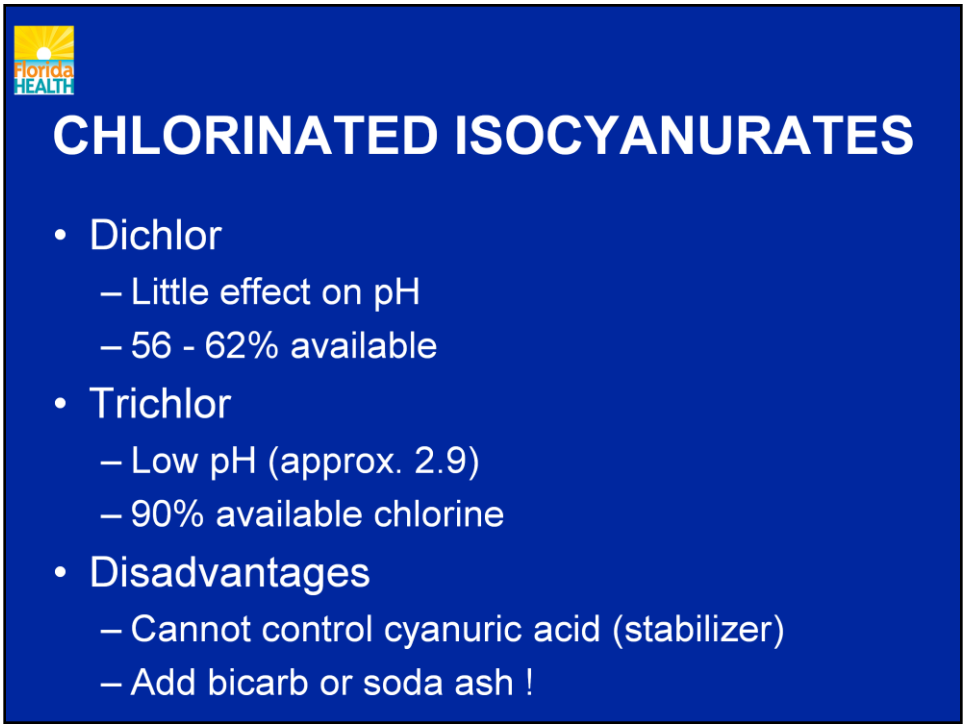
Disadvantages include clouding the water when added and damaging of the pool surface, it can also raise the calcium level in the water and cause scaling.

Calcium hypo is good for algae treatment because of the 65% available chlorine; it can pack a good punch.

CALCIUM HYPOCHLORITE (continued)

- DON'T ADD CALCIUM HYPO PELLETS TO A TRICHOR OR BROMINE EROSION FEEDER
- BOOM !

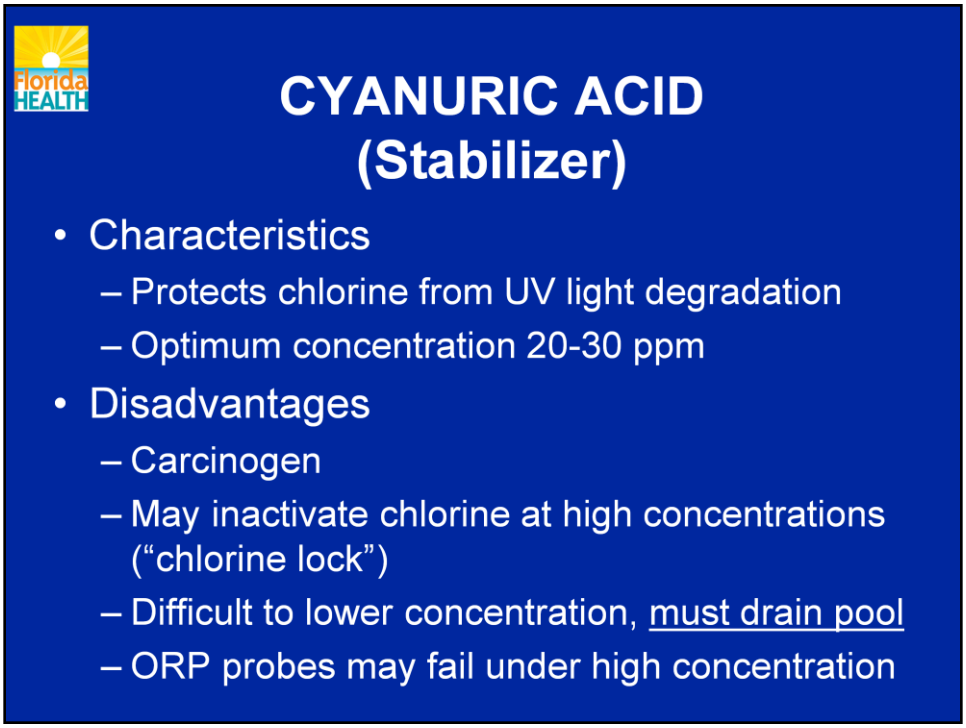
It is very important to remember to never add calcium hypo pellets to a trichlor or bromine feeder, because it can **explode.**



. Next are chlorinated isocyanurates, which are used in erosion feeders. These come in two forms: trichlor and dichlor. Dichlor has little effect on pH, and has 56-62% available chlorine. Trichlor has a low pH and 90% available chlorine. A disadvantage of these is that they contain cyanuric acid as part of their structure so it's difficult to control the stabilizer. This is why they are no longer allowed for use on spas.

Trichlor is 90% chlorine and it has stabilizer in it, have to drain and refill the pool/spa to control it. The revised code now requires bicarb feeders on all pools and spas with erosion feeders so you cannot just take out stenners anymore and slap on an erosion feeder! You MUST have a pH adjustment feeder now, a stenner feeding soda ash or bicarb.

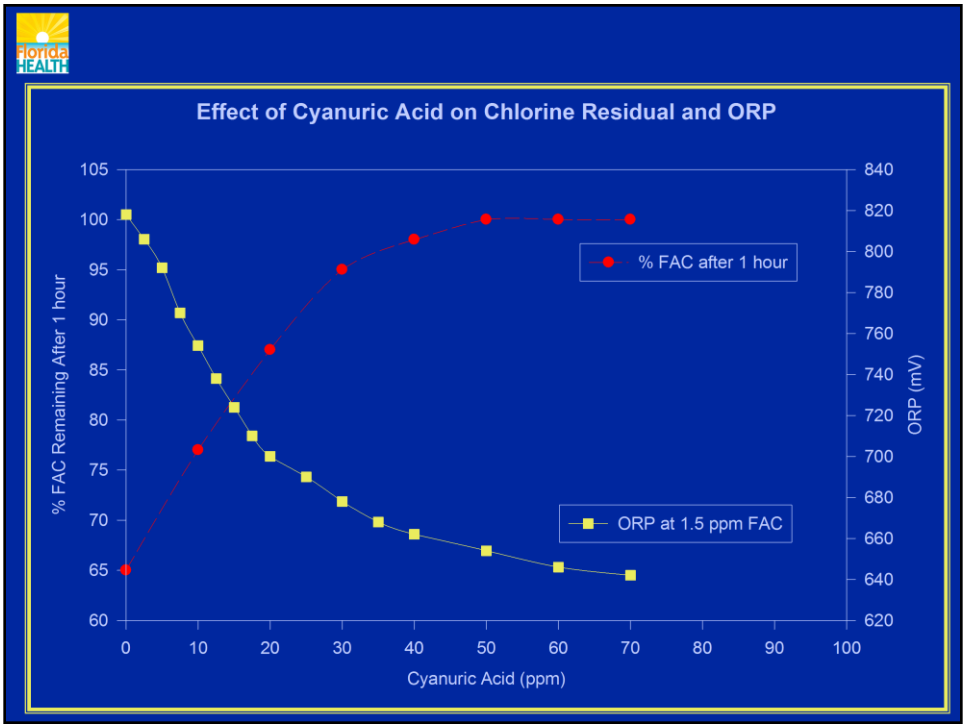
A lot of your algae treatments are jus Trichlor or Dichlor granules in a fancy package, read the ingredients and buy generic if it is just Trichlor.



Cyanuric acid is also known as stabilizer. Some advantages are it can protect the chlorine in the pool from UV light degradation. Half the chlorine in your pool can be burned up by sunlight in 1 hour.

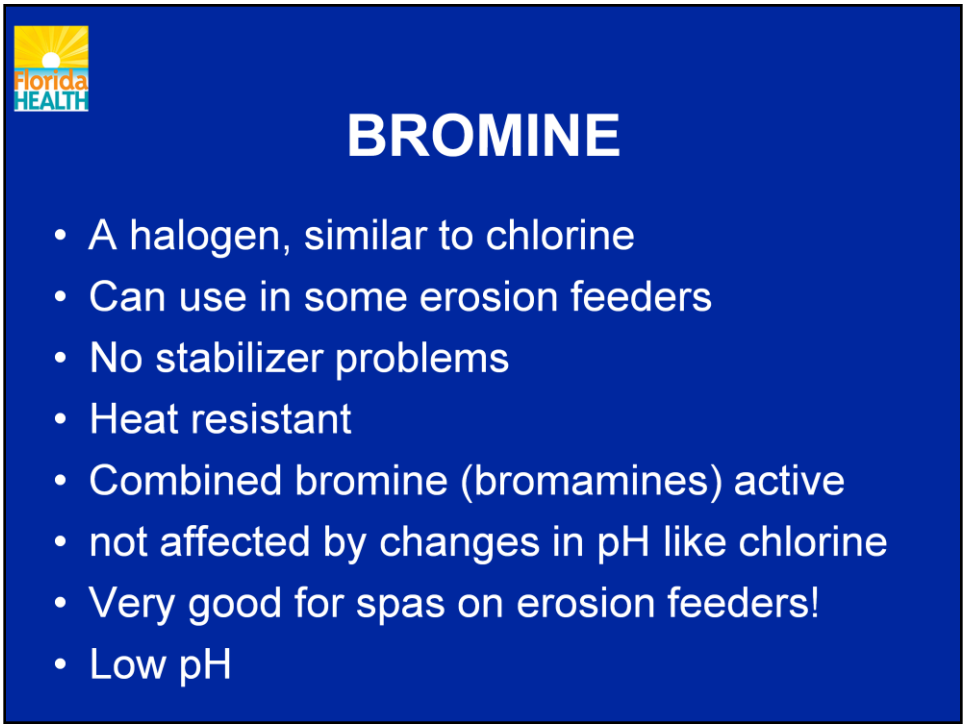
Disadvantages are that it's a carcinogen, it can inactivate the chlorine at high concentrations causing chlorine lock, and if you have an ORP controller the probes may fail under high concentrations. The optimum concentration to have your cyanuric is between 20-30ppm.

The maximum cyanuric level in a spa is 40ppm; in a pool the maximum is 100ppm.



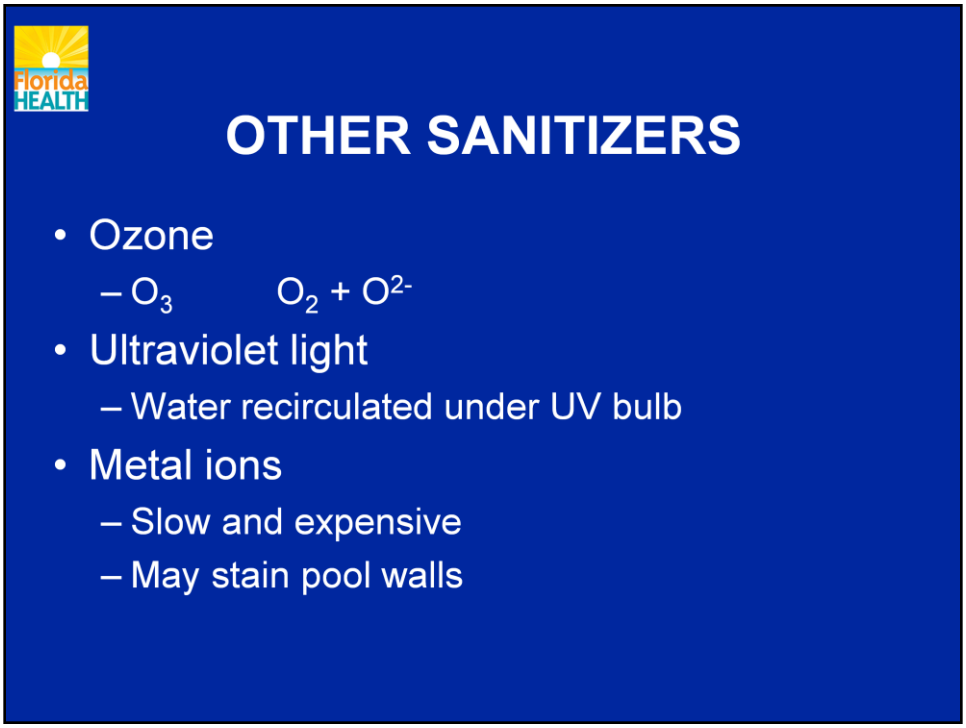
This chart shows how cyanuric acid affects the chlorine and the ORP controller. The yellow line is the ORP, that's the oxidation reduction potential, and is the ability of the chlorine to do the work. You can see that as the cyanuric goes up, the ORP of our chlorine goes down, so the chlorine is locking up.

The red line shows the percent of chlorine remaining in the pool after one hour's exposure to sunlight. As the cyanuric goes up, more chlorine stays in the water, but around 40ppm this levels off. After 40ppm you don't see much more benefit, and the chlorine starts to take a dive, so it's best to keep it under 40ppm.



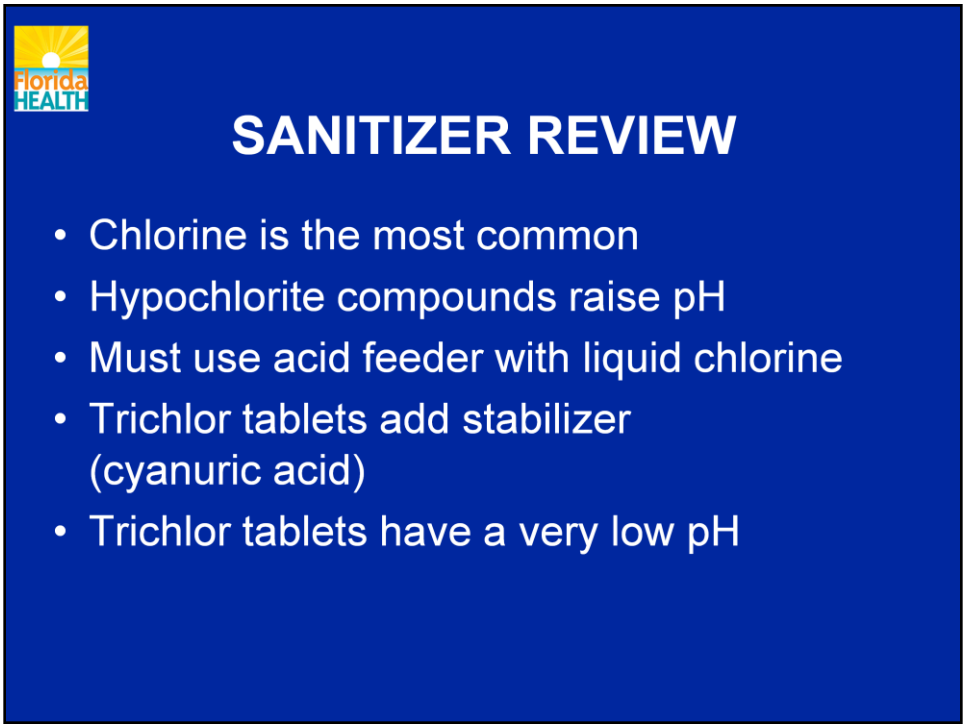
Bromine is hypobromus acid. It's part of the halogen family of chemicals like chlorine.

It can be used in erosion feeders on spas and wade pools because it doesn't have stabilizer. It's heat-resistant and isn't affected by changes in pH like chlorine is.



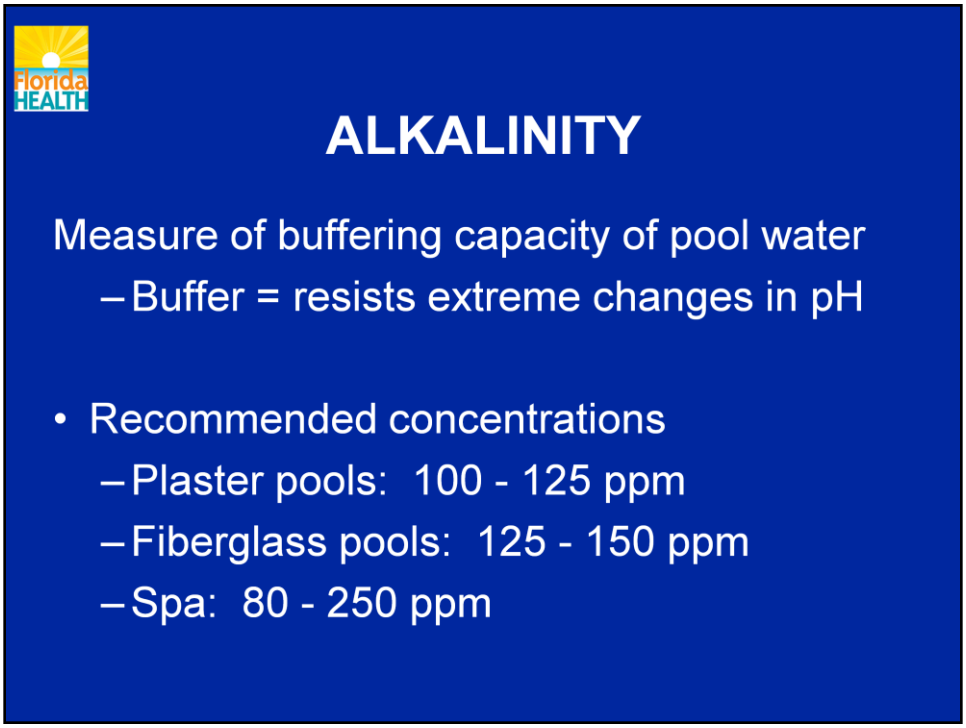
Some other sanitizers that can be used, like ozone, ultraviolet light and metal ions, are considered supplemental disinfectants. The state code still requires a disinfection system that keeps a residual in the water, so a chlorine system is still needed.

Ozone is good on systems for kids like play fountains because it kills crypto quickly. Shortwave UV radiation can kill bacteria and are effective against crypto and giardia. Metal ions are rarely used because of the expense and the fact that it can stain pool walls.



Sanitizer review

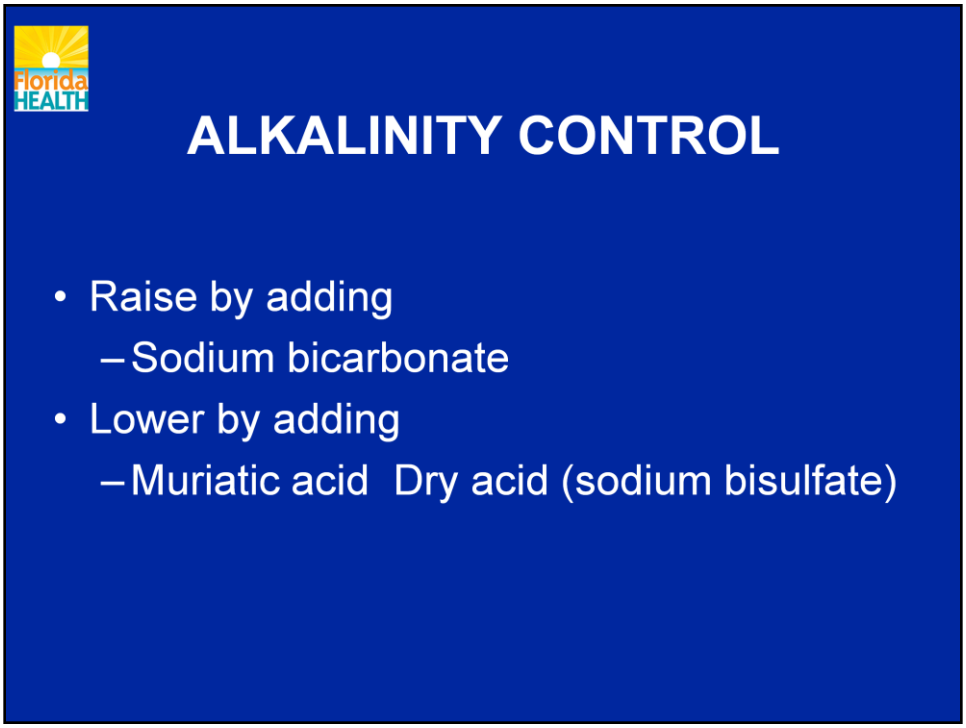
1. Chlorine is the most common sanitizer used.
2. Hypochlorite compounds will raise the pH in a pool, which is one reason why you must use an acid feeder with liquid chlorine.
3. Trichlor and dichlor tablets add stabilizer to the water, and trichlor has a low pH.



Alkalinity is the measure of the ability of water to resist changes in pH. Alkalinity acts as a buffer for your pH, keeping it where it needs to be. Without it your pH can bounce all over the scale.

When this happens the water can become out of balance and affect the chlorine's ability to kill bacteria. It can also cause corrosion, staining, scaling and eye/skin irritation.

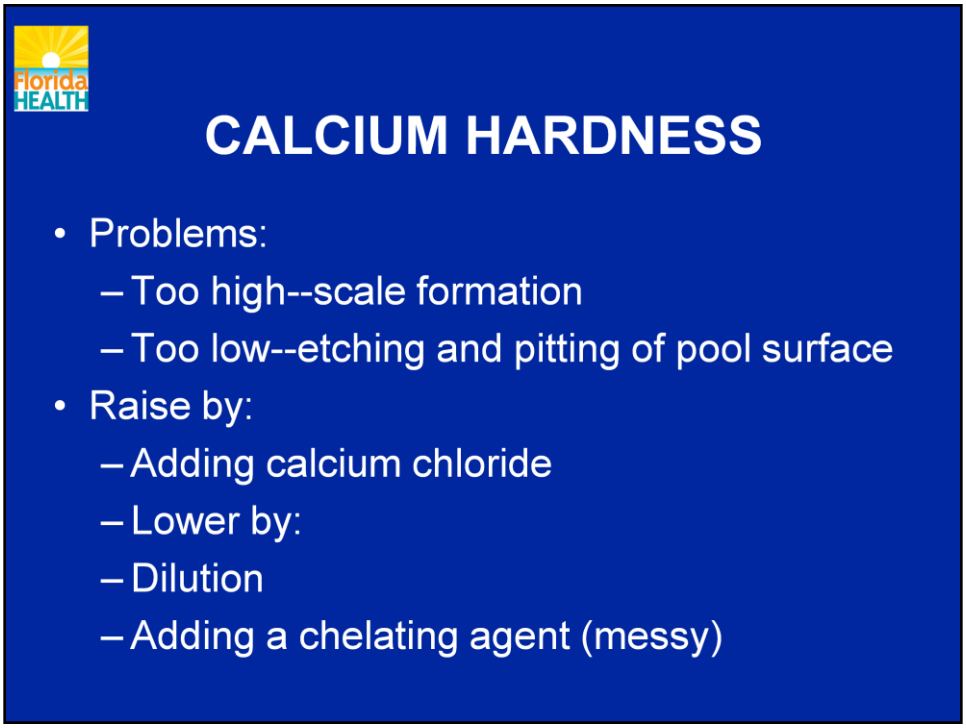
If your pH is low, your alkalinity will also be low. Recommended alkalinity levels are based on the type of surface used.



To control your alkalinity you can raise it by using sodium bicarb, or lower it using dry or muriatic acid.

If you accidentally added too much bicarb and your alkalinity is through the roof, you can get rid of it buy adding an acid. Bicarb is a base (OH-)

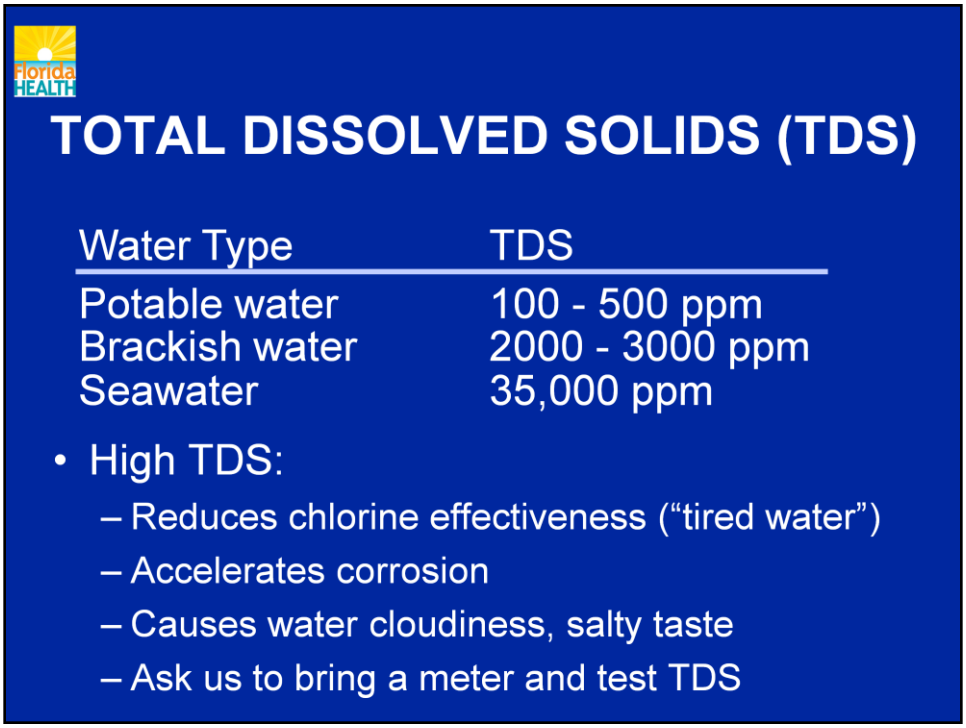
This is a test question, what would you use to lower total alkalinity? Dry acid!



Calcium is naturally present in water. The ideal calcium level in pool water is 200-400ppm. If it's too high it can cause scale formation, and too low a level can cause pitting and etching of the pool surface.

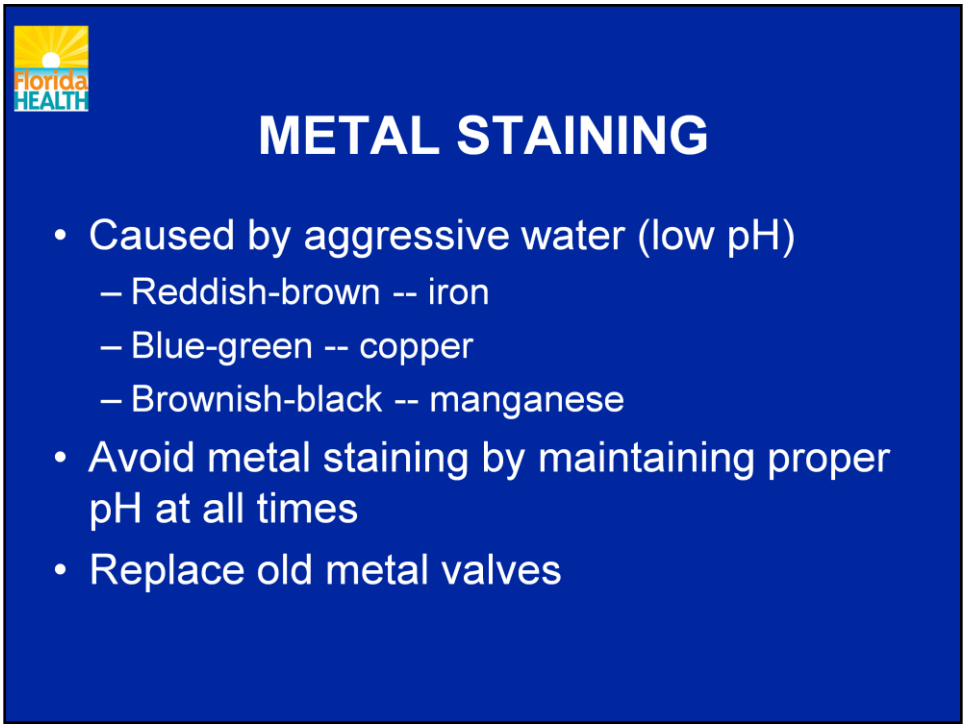
If you notice while performing your chlorine test that the water turns milky after you put in 5 drops of #1 it may be because you have hard water, and there's too much calcium.

A low calcium level can cause foaming in spas. To raise the calcium level you can add calcium chloride. You can lower it by adding a chelating agent that will glob the calcium together to be filtered out, but it's a messy procedure. The best thing to do is drain and refill with fresh water.



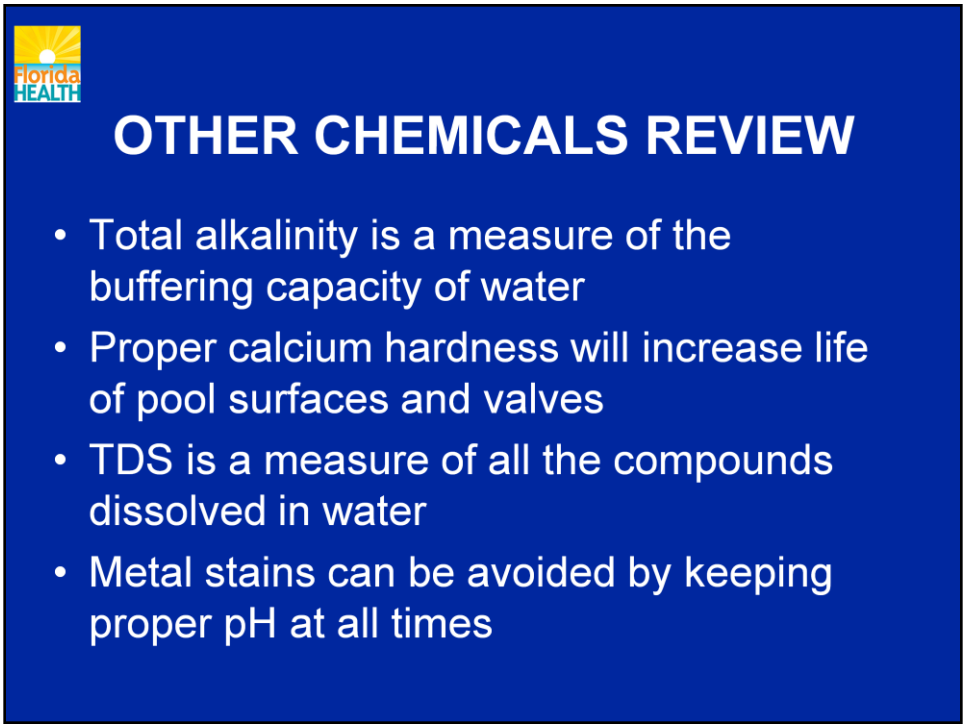
Total dissolved solids, or TDS, is the measure of all the stuff in the water. It’s the total weight of all soluble matter in the water. The list here shows the level of TDS based on the type of water. Any dissolved matter added to the water will contribute to your TDS, like salt, bather waste, algicides and defoamers.

When people complain that the water tastes salty it’s usually because the TDS is high. High TDS can reduce the effectiveness of the chlorine, making tired water, it can accelerate corrosion, and causes cloudy water and a salty taste. The Health Department can test TDS for you, just ask your inspector.



Corrosive water conditions, like with a low pH, can dissolve pool walls, handrails, ladders, heater components and pump impellers. The presence of iron, a red/brown color, can be from source water and/or erosion of circulation components like the pump.

The blue/green color of copper is most commonly caused by poor water balance management. Manganese, a brown/black color, can come from source water or from the use of certain water treatment chemicals. You can avoid metal staining by maintaining the proper pH at all times, and replacing old metal valves.

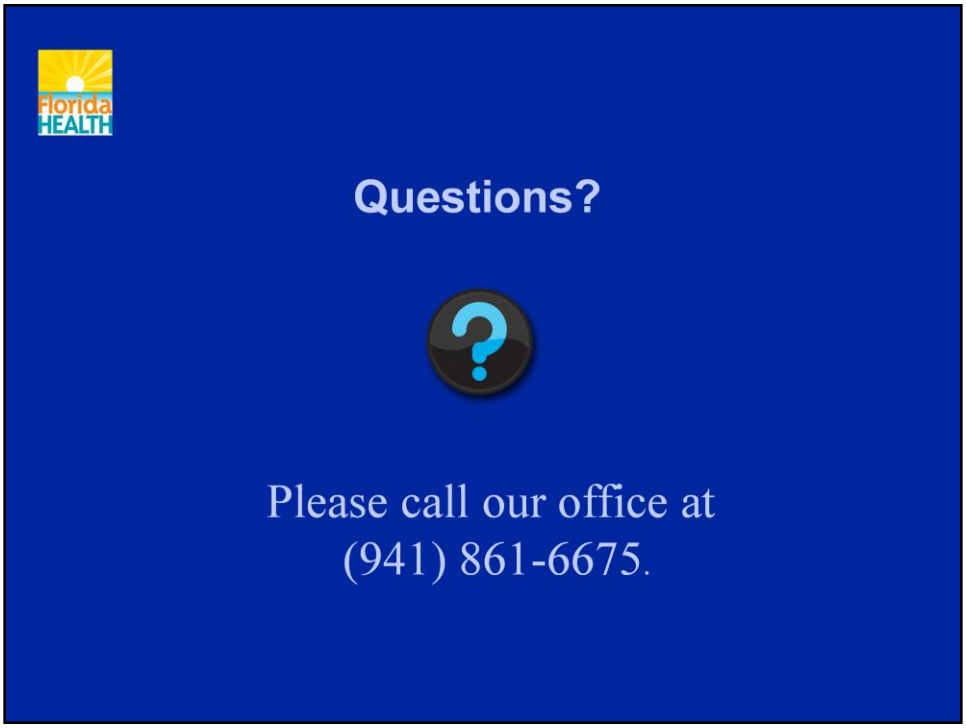


Other chemicals review

1. Total alkalinity is a measure of the buffering capacity of water.
2. Proper calcium hardness will increase the life of pool surfaces and valves.
3. TDS is a measure of all the compounds dissolved in the water.
4. Metal staining can be avoided by keeping a proper pH level at all times.

Always read the labels on your chemicals, and don't mix them. Make sure your chemicals are sealed and labeled at all times. Ask patrons to leave the pool before adding chemicals directly to the water, because you cannot broadcast anything into the pool while there are people in it, and always keep the pool closed for an hour after you broadcast.

It is also important to keep your feeders electrically interlocked, so if the pump shuts off the chemicals will too, and you won't have a big push of chemicals go through the system when you turn the pump back on.



If you have any questions about anything that was discussed, please give us a call.