FACILITIES DEVELOPMENT

USA Swimming
1 Olympic Plaza
Colorado Springs, CO 80909
mnelson@usaswimming.org snelson@usaswimming.org
www.usaswimming.org/facilities

These are some IMPORTANT facts about owning, operating, or using a pool/spa:

Each area's water quality is different. If you try to treat water in the Mid-west like a person treats a pool in Arizona or Florida, you will be in for an unpleasant surprise - IT WON"T work. Many areas have metal laden water with a high nitrate content. Some also a high sediment rate of suspended matter in the water. Be aware of what "BRAND" of chemicals are being used. The wrong brand in the wrong area can create a whole set of problems that are both time consuming and expensive to correct and unfortunately the chemical manufacture will not alert you of what to look for.

There are 2 components to having CLEAR WATER. (1) Proper circulation (2) Proper chemicals
If the pump is not properly sized or the filter is not the proper size or type, green water or cloudy "murky" water may result. Many pools are designed (through "value engineering") with too small of pump and filter; some are up to 3 times too small for the pool. A professional pool company can size your filter to your pool. You may use chemicals with calcium as the inert ingredient, or you may need to learn about technical-grade sodium based chemicals and what buffers or binders they use. Every area of the country is different.

One of the 2 most important water test you can do on a daily basis is pH - the RED indicator. If your pH is not between 7.3 and 7.6 none of the chemicals you put in the water - including chlorine - will work properly. To raise pH use soda ash. To lower pH use sodium bisulfate. Baking soda (sodium bicarbonate) will also raise pH or Muriatic Acid will lower pH in certain circumstances. Certain pH control chemicals can throw your total alkalinity out of balance and cause large problems. 45 minutes after adjusting the pH, test the water to see what was accomplished. Retreat if the readings haven't changed. Add pH-adjusting chemicals through the skimmer, gutter, or through an in line feeder.

Test kit indicators - the clear liquid with the yellow lid for chlorine and the red liquid with the red lid for pH - are not good for more than 12 months. Replacement bottles and complete test kits are sold at the local pool dealer. Test strips do not work well or read accurately - stay with the liquid 5-part test kit. In addition to the daily Chlorine and pH test, test regularly for available chlorine, total alkalinity, and cynauric acid level. Most State Department of Public Health's Swimming Pool Divisions require many more test than just Chlorine and pH. All test must be recorded and the pool logs kept on file.

Pool Water Testing The goal is to maintain a healthy, clean pool environment. Proper control of all the variables involved in pool chemistry is assured only by constantly monitoring the water, evaluating the findings, adding chemicals, and maintaining automatic chemical feeders as necessary to control proper water balance. There are many different types of test kits – some rated for residential pools and others for commercial applications. Electronic controllers that read, evaluate, and mechanically adjust the pool water chemistry have simplified the testing and maintenance procedures associated with water chemistry balancing but in many instances unique water qualities make these inaccurate and inconsistent. Regardless of the system used, all applicators must follow basic rules when testing water. Disinterest, sloppy instrument handling, hurried procedures, bad reagents, poor choice of sampling location, or inaccurate measurements will lead to problems.

The following rules apply to all commercial chemical testing:

1. Most states require that pool water be tested at least twice a day with the results recorded on a daily operational sheet. Test at times when the pool is used during normal peak periods of use.
2. Make certain that the sample is representative of the pool water. Select a sample location that contains well-mixed pool water. Obtain sample from at least 6" below the water's surface. Do not collect the sample from in front of an inlet or from a surge tank.
3. Follow test kit instructions—water testing is a precise process that demands accuracy in measuring amounts of reagents involved and in observing time and temperature requirements.
4. Rinse all solution tubes and equipment thoroughly after each use, both inside and outside. Do not rinse droppers or reagent bottles, or let the droppers touch pool water. Do not handle the equipment or reagents with dirty hands. Rinse off any reagents that get on the skin.
5. Properly box or case the equipment, and store in a cool, clean, dry place. Do not interchange parts such as solution tubes, bottle caps, or droppers. Reckless or inexact methods of water testing leads to inaccurate results and possibly an unsafe condition for people using the facility. Water must be kept in a healthy, clean and clear condition at all times.

Testing for Chlorine (2xdaily - minimum) There are three types of chlorine test readings: free, combined, and total. Free chlorine plus combined chlorine equals total chlorine. Only the free chlorine is effective in killing bacteria or algae. The combined chlorine is bound with other elements (contaminants) and needs further chlorine additions (oxidizer) to release it. Orthotolidine testing (OTO) reveals only the amount of total chlorine found in the pool water and does not distinguish between free available and combined chlorine levels. If the amount of combined chlorine reads higher than that of the free chlorine, problems are present. Ideally the free chlorine level should be kept around 1.5. Any higher than that, water and air problems may be created. If using a UV system this reading may be decreased to 1.0 or less – check with you state Dept. of Public Health – swimming pool division for their requirements.

DPD Testing (bi-weekly minimum) The quality and type of test kits vary. DPD testing kits are used to test for free available chlorine (F.A.C.), combined available chlorine (C.A.C.) commonly called chloramines, and total available chlorine (T.A.C.). If there is a chloramine problem or pH problem swimmers will complain of red, irritated eyes and strong odors. This is a very serious health hazard and must be immediately addressed.
NOTE: Liquid reagents have an 8 month to one-year shelf life. The accuracy of the test is likely to decrease if reagents are stored inaccurately or for long periods of time. Keep in a cool dry place out of the sunlight.

Testing pH (2xdaily) The pH of water is usually tested by matching reagent colors against a colormetric standard. The reagent generally used for swimming pool water is phenol red, which has a pH range of 6.8 to 8.4 and a corresponding color range of yellow to red. There are 2 distinct types of phenol red – a "J" solution (residential) and a #4 solution (commercial). Knowing the pH of pool water is essential for properly controlling all the water chemistry parameters. Test pH at least daily, or 2 times a day when the disinfectant residual is checked. Confirm that the pH is within the desired 7.3 - 7.5 range. Take water samples from the pool for testing the pH, not from a pipe tap or in the equipment room. pH can be lowered with Sodium Bisulfate or Muriatic Acid. pH can be raised with Soda Ash or Sodium Bicarbonate.
Note: Remember when dissolving chemicals, add chemicals to water; never add water to chemicals.

Testing for Calcium Hardness Levels (monthly) Total hardness is the measure of calcium (Ca) and magnesium (Mg) in the water. Excessive hardness—the combination of calcium [Ca] and magnesium [Mg]—causes calcium scale to build up on the walls and floor of plaster finished pools and spas and also on liners, tile, and fiberglass. It also leaves scale build-up in heaters, heat exchangers, and other filtration components. Recognize that it is not the magnesium that forms the scale, only the calcium forms scale. When the hardness level drops too low, the water becomes aggressive and will cause corrosion, pitting of plaster, and grout to dissolve. Control of scaling or aggressive water requires the calcium hardness level to be kept above 200 ppm and below 400 ppm. Calcium chloride (CaCl) is used to increase the hardness level.

Testing for Total Alkalinity (monthly) Alkalinity in water represents the amount of bi-carbonates, carbonates, hydroxide and sometimes borates, silicates and phosphates. Total alkalinity is the resistance of water to changes in pH. The higher the total alkalinity, the more difficult it is to change the pH with soda ash or acid. Testing for total alkalinity is essential to make proper determinations of the saturation index as well as for bather comfort and ease of pH control. Total alkalinity (calcium carbonate) should be kept between 80-120 ppm for pools with inert liners, and between 100 to 125 ppm for pools with plaster finished surfaces. Pools with source water with alkalinity over 200 cannot use CO2 for pH control.

Total Dissolved Solids (TDS) (monthly) Total dissolved solids (TDS) is the measurement of all materials dissolved in the water, i.e. calcium, dissolved organic and inorganic materials, carbonates, salts from chlorine residue, swimmer waste, soluble hair and body lotion, or anything placed in the pool that can be dissolved. The total dissolved solids (TDS) in a pool should not exceed 1,500 ppm. High TDS is common with spa water with high bather load, high chemical needs and a relatively small volume of water. TDS can only be corrected by dilution with water with low TDS or completely draining and refilling with fresh water. TDS levels requires a special test kit.

Cyanuric Acid Testing (monthly) Cyanuric acid is commonly added to outdoor pools as a chlorine stabilizer or chlorine conditioner. The concentration of cyanuric acid must be monitored carefully to insure that the chlorine does not become over stabilized. Cyanuric acid products are not recommended for indoor pools and spas, since the need for chlorine protection from the sun is not a concern – however – many chemicals used in indoor pools and spas have small amounts of stabilizer (used as a binder or buffer in the manufacturer process) that can build up over time.. The acceptable range of cyanuric acid is generally between 30-80 ppm. Tests are based on turbidity (cloudiness) or metal fallout. Cyanuric acid is also called stabilizer, conditioner, and sun-screen. The only way to lower Cyanuric levels is to drain the pool or spa. Year round pools tend to have more challenges associated with iso-cyanurics than seasonal pool that drain their water and start fresh every year.

Copper Testing (monthly) Copper found in pool water contributes to staining of pool walls, water discoloration, and turns hair or nail cuticles of the pool users green or blue. Therefore, the recommended copper level is less than .02 ppm. If copper is present, maintaining a pH of 7.4 to 7.3 and a hardness of 350 ppm reduces the negative influences of copper.

Iron Testing (monthly) Dissolved iron is responsible for staining and color problems in pool water and on pool surfaces. The addition of chlorine in an adequate concentration helps to precipitate out the iron and allows the DE filter to remove it. Sand filters will usually just keep recirculation the iron until it either ends up on the bottom of the pool or goes back into suspension. Products that claim to "hold the iron in suspension" are expensive and do not work well.

Test Strips for Water Chemistry Levels (not allowed in most commercial applications) Test strips are available to determine chlorine and pH values as well as all other parameters of water chemistry. These test strips are easy to use but they are only useful as general guidelines and in the presence of high metal concentration in the water or water over 84 degrees they are pretty much useless. Do not rely upon test strips for accurate water chemistry readings.

Record Keeping - When performing water tests, keep a written record of the results. This information is helpful for understanding the dynamics of the pool's system. Over time, you may notice trends and be able to anticipate water needs and keep a tighter control on water quality. This information is also required by the State Department of Public Health.

Summary of Water Chemistry Testing. To insure proper water quality and sanitizing levels of any swimming pool or spa pool, you must have a working knowledge of all parameters effecting water chemistry and must be familiar with water testing equipment. Testing equipment must be maintained in clean conditions, and fresh reagents used for achieving accurate results. You must record the results of testing activities.

Temperature Water and air temperature should be monitored and recorded twice daily. There is an abundance of mis-information published about the relationship between air and water temperature. Do your homework and use common sense.

Filtration The water chemistry can be perfect but if the filtration or circulation is inadequate, all is for naught. Proper filtration is 50% of the water clarity equation. There are 3 main types of filters:

Sand (40 microns)
Cartridge (15-20 microns)
DE (4 – 9 microns)

The smaller the size-number of microns the better the filtration. Assuming the pump is sized properly, DE is the most effective form of filtration. Filters must be cleaned on a maintenance schedule and media changed. Proper monitoring and maintenance is imperative. Many times water conditions warrant the use of more than one type of filter (e.g. Sand filters can use Cartridge filters as a scrubbing or polishing filter when installed after the filter/pump/heater and before water returns to the pool. A valved piping loop will allow the cartridge filter to be used when necessary.

Liquid Chlorine has become a preferred method to treat pool water. Using "cheap bleach" from the store is not the same as using a commercial liquid chlorine. Make sure the liquid chlorine being used has no "stabilizers" as a base or buffer. Read the label carefully and learn what the "terms" mean..

All chlorine's/bromine's are not the same - in fact - seldom are any 2 identical. Some use calcium, potassium or lithium for a base. Others use industrial or technical grade sodium. It is not the chlorine that makes one brand superior to another, but the base and the inert ingredients and the processing methods. Some of the chlorine's on the market today are not suitable for pool use. So why do they sell them ? Because people buy them and then buy the "corrective" chemicals to solve the problems they create. A large amount of the advertising for pool chemicals is FALSE and the pool owner/manager is the only one who suffers. Learn what a chlorine will and won't do and stay with one brand that services the established needs.

…..the same advice about ALGAECIDES, except there are even more products to choose from. Polymer based algaecides seem to work best and have no undue side effects. Again, watch out for the inert ingredients. Algaecides come in different concentrations, the more expensive bottle with the higher % of active ingredients may be the most economical to use in the long run. Also - there is NO SUCH THING as an "algaecide block" or an algaecide that you use once a month or less often. Stay away from products that promise "easy answers".

Many times, GREEN WATER is NOT caused by Algae. It is usually caused by a chemical reaction that knocks the metals out of the water. Sometimes this can be the fault of the type/brand of chemicals used, other times the fault of the filter, then sometimes the problem can be more complex. Regardless of the cause, the problem cannot be solved by adding chlorine, bleach, muriatic acid, clarifiers, algaecides, shock, or metal out. This simply compounds the problem and makes it harder to correct. Get a water sample to the nearest reputable pool dealer so they can help correct the problem.

"SHOCKING" the pool can be best defined as "throwing money down the drain". The term SHOCK has been mis-used more than any other in the pool industry. Procedures that are commonly called SHOCKING are:

1. *Adding an Oxidizer (*Potassium Peroxy Monosulphate = brand names Oxykleer or Oxybrite and others) *to the water to convert the available chlorine to free chlorine*
2. *Breakpoint chlorination - raising the chlorine to 10.0 or above (superchlorination)*
3. *Hyperchlorination – raising the chlorine to 20.0*
4. *Adding chemicals to start your pool in the summer or close your pool for the winter.*

Don't do any of these unless experienced with the process and know what is trying to be accomplished.

Note* If chloramines are being formed in the water most Health Departments will advise Super or Hyper Chlorinating. This sometimes will work, but the pool will be closed down until the pool reaches a swimmable condition – usually 3.0 total Chlorine count or less – then letting the water settle back down to 1.5. A more realistic approach is to find out WHY chloramines are being formed. It may be better to consider a type of filter that helps remove chloramines (DE or cartridge filters as compared to Sand filters) or look into an UV (Ultra Violet) system that breaks down chloramines. The type or brand of chlorine being used also needs to be considered.

Never add chemicals to SUSPEND the metals in the water or SEQUESTER the metals. Most of the metal inhibitive products do not work and they can actually stop the proper treatment for the water from working for up to a month. They are also very expensive – especially for large pools.

Stabilizing or sun screening the water can save some money over the summer season. Stabilizer is not necessary but it can make sodium based chlorines burn more effectively in the hot sunlight. Stabilizing is something not just done automatically every season because the chemical in stabilizer last for years in the water. If too much stabilizer is in the water nothing will take it out – the pool will have to be drained. Test the water for cynauric acid content to see how much stabilizer is needed. Do not stabilize indoor pools.

To make pool accessories (hoses, vac-heads, nets, games, etc.) last as long as possible, store them out of the direct sunlight when not in use. The ultra-violet rays of the sun cause deterioration of any thing made from plastic-type material. Protect filter hoses and filter housing from as much sun as possible. Most commercial accessories and pool covers/liners are made with ultra-violet inhibitors in the material. They only cost slightly more than the standard pool accessory but will last noticeably longer.

When pump/filter is on a timer to save electricity by turning off at night, the pool will experience a higher chemical usage. After the water has been setting (un-filtered) for 3 hours the chemical life has been cut in half. More than 3 hours it has been by 2/3. So saving $2 in electricity may cost $5 in pool chemicals. Lack of proper circulation is the main cause of improper oxidation of chemicals. In addition, pool pumps will last longer if allowed to run continuously. Someone is probably out-smarting themselves by shutting filter on & off frequently.

When adding make up (fresh) water to pool, add directly to the piping before the filter if possible. Adding the water in the pool may cause chloramine problems.

Many times, the pool owner/manager is their own worst enemy. They talk to a friend who owns a pool and they said someone else tried this or uses that and it works great; so they try it. DON'T DO IT ! Very seldom will a person admit to trying something that failed. They feel stupid. Most - or all - of the "miracle treatments" are "urban legends" started by the manufacturers or re-sellers. People can try a gimmick chemical 4 or 5 times and 1 time it may have seemed to help. That's the time you'll hear about - and probably it wasn't the chemical that did the trick, just a coincidence. Here is some good advice to follow:

1. If something works for you, don't change it. Also - don't expect it to work the same for someone else.
2. Do exactly what your pool professional recommends. If you don't have confidence in you pool pro, change the place you do business. When you have a pool problem, tell your pool pro everything you did. Don't leave out the fact that you added some discount store chemicals because you were temporally insane. Without all of the facts, the proper solution may not be reached.
3. There is more to taking care of water than adding chlorine and vacuuming. Learn as much as you can, and never assume you know all of the answers. Ask you pool pro for assistance.
4. NEVER - NEVER - listen to the advice of a friend. Would you take nitro glycerin tablets to make sure your heart stayed healthy? Don't add STUFF to your water unless a pro has recommended it and tested your water first.

5. Keep track of what is spent so at the end of the season you know how much it cost to operate the pool. This is the only way you can prove-to-yourself that not only are a specific brand of chemicals better and easier to use, but they actually save money when looking at the entire pool season."
6. For on line water technician courses contact *www.aquaticpartners.com*

NOTICE! Many gimmick chemicals are introduced to the USA pool market each year. Before jumping in to anything NEW, do research. Most of these chemicals or treatment systems will damage pool equipment, will cost more to use, and will not kill all types of dangerous bacteria. Resist the temptation to save-a-buck. If you feel uncomfortable about asking people in your area you can call your local Department of Public Health - Swimming Pool Division – or call USA Swimming Facilities Division at 719-866-3522 – e-mail *mnelson@usaswimming.org* Most of the gimmick chemicals have already been banned for commercial use in pools and spas. Example: http://aem.asm.org/cgi/reprint/69/5/2505.pdf

WATER WARNING ! DANGER ! RWI (Recreational Water Illness) it has always been there but now it is being is being detected sooner. Chlorine-Bromine-and other chemicals do not kill them as quickly as needed especially when pH and other water balance factors are not correct. Some of the causes:

- Changing children's diapers poolside exposing baby to pool water without showering after diaper change
- Not washing hands after using restroom and not showering (with soap) before entering pool
- Swimming with diarrhea
- Aquatic shoes being worn to bathroom and then back to pool
- High-pressure deck washing blowing bacteria into pool water
- Swimming after going to bathroom without proper cleaning

Identifying the ENEMY:

- Cryptosporidiosis – *Parasite is resistant to germicides and bactericides and can live in pool up to a week. Highly contagious. Transmitted by swallowing water and people contact. Causes dehydration, weight loss, stomach cramps, fever nausea and vomiting. No treatment.*
- Escherichia coli (E-coli) – *Bacteria controlled by proper chlorination. Transmitted by swallowing water. Causes bloody diarrhea, abdominal cramps, kidney failure. Treated with antibiotics.*
- Giardiasis – *Parasite can last less than an hour in a properly chlorinated pool- the cooler the water the longer it can survive. Transmitted by swallowing water. Causes diarrhea, gas, stomach cramps, nausea and upset stomach. Treated with prescription drugs.*
- Hepatitis A – *Virus is mildly resistant to germicides and bactericides and can live approximately 15 minutes in a properly chlorinated pool. Transmitted by swallowing water. Causes jaundice, fatigue, loss of appetite, diarrhea, fever, stomach pain. Vaccine available but no treatment after the fact.*
- Legionnaires' Disease / Pontiac Fever – *Bacteria killed in less than a minute in a properly chlorinated pool. Transmitted by inhaling mist from hot tubs or spray features – not contagious. Causes fever, chills, cough, aches, fatigue, diarrhea, kidney malfunction. Treatable if diagnosed in time.*
- Naegleria Infection – *Microbe that enters through nose and affect brain and spinal nerves. (Rare) This ameba lives less than a minute in a properly chlorinated pool. Causes meningoencephalitis. Prescription drugs available if immediately diagnosed.*
- Norovirus Gastroenteritis– *Virus that has a mild resistance to germicides and bactericides and can live approximately 30 minutes in a properly chlorinated pool. Transmitted by swallowing water. Causes nausea, vomiting, diarrhea, stomach cramps, flu like symptoms. No treatment specified – people usually recover on their own in 48 hours.*
- Pseudomonas Dermatitis – *Bacteria controlled by proper chlorination. (Hot Tubs and pools) Transmitted by direct skin contact with/in water. Causes itching, rash, blisters – not contagious. Clears up on it's own in about 48 hours.*
- Salmonellosis – *Bacteria controlled by proper chlorination. Transmitted by swallowing water. Causes diarrhea, fever, cramps. Antibiotics available for more serious cases.*
- Shigellosis - *Bacteria controlled by proper chlorination. Transmitted by swallowing water. Causes diarrhea, fever, cramps. Treated with antibiotics.*

Prevention:

- Post signs warning of the risk of swallowing or putting pool water in mouth
- Enforce showering rules and proper standards for cleanliness
- Test water 3 times a day (or more) for proper chlorine and pH readings
- Make sure all filter systems have fresh media and are properly cleaned on a regular schedule
- Add an Ultra Violet system to water treatment
- Include educational material in all policy and procedure manuals and patron flyers

Fresh Air – Fresh Water

We have been "circling the wagons" with the "pool atmosphere" concept for quite a few years now. There are literally a dozen or more "expert" opinions on water and air quality and almost all of them have some good points. At the present time over 50% of the Facilities Development Department's "please solve my problem" type calls have to do with poor air quality. The information listed below is written in lay-persons terminology and may help you investigate and solve your specific problem.

First & Foremost: Air Quality and Water Quality are dependent on each other. Air quality will be affected by:

- The amount of fresh air that is being introduced into the building every hour. *A 90% change of air every 20-25 minutes works well.*
- The condition of the air handling equipment filters. *The filters should be cleaned or changed every 3 months. There are micro-filters that filter out more air-borne contaminates than the standard fiberglass or paper filters.* (Tip about lubricants)
- The type of air handling system you have. *Do you have a Desert-Air type system and is it regularly serviced and working properly?*
- Routine maintenance must be done and tracked on all pieces of air handling equipment. *Vents and louvers must be checked and lubed at least 4 times a year to make sure they are working properly. Motor belts and fuses also need to be checked.*

If the air smells like chlorine – something is wrong. That acrid smell we sometimes associate with chlorine is usually ammonia. In the swimming pool industry the "cause of this odor" is called "chloramines". Chloramines (combined chlorine) occurs when free chlorine combines with ammonia and other nitrogen compounds. This "combining process" can be accelerated by perspiration, urine, saliva, body oils, lotions and some shampoos/soaps, fertilizers, and many industrial or household cleaners. The odor is created when water is not properly balanced . The odor intensifies when swimmers agitate the water – as in kicking or general warm-up swimming. The odor is worse at water level but can be extremely irritating at deck level or in the viewing area. Many times not only an odor is noticeable but eye irritation is also experienced. Sometimes the water may be hazy – but not always. Many times, the water will appear perfectly clear and the water test for free chlorine and pH reads normal.

This has become such a widespread problem in indoor pools that literally hundreds people are hospitalized each year. People with Asthma can find themselves in Intensive Care if exposed to this type of pool condition for even a short period of time. Most of the problems occur in indoor pools. Outdoor pools have plenty of fresh air and sunshine (ultra violet light) so they are not as susceptible to the chloramines problem.

Chloramines formation can be accelerated by:

1. Swimmers not properly showering before entering pool.
2. People using the pool rather than getting out and going to the restroom.
3. People doing a high level of aerobic activity and sweating in the water. *(everyone sweats in the water – the same as if they were doing exercise on land)*
4. Residues from ammonia based cleaning products that are used on decks or in shower rooms/lavatories.
5. Residues from fertilizers used on landscaping (nitrogen based) that get tracked into building on everyone's shoes.
6. Poor air circulation and lack of fresh air introduction into the pool building.
7. Over use of "shocking" the pool for maintenance purposes.
8. Improper use of certain brands of chemicals not suitable for conditions specific to a geographic area.
9. The water company artificially adding chloramines to the water supply – a practice that is common in most cities.

So – what do we do if this occurs ?

Let's divide the answer into 2 parts:

1. short term solution
2. prevention

SHORT TERM SOLUTIONS: If Chloramines are detected the most prevalent solution is to "shock" the water. This means super-chlorination (break-point chlorination) or raising the level of chlorine in the pool to 10 parts per million. Normally a dry chlorine powder or a liquid chlorine is used to achieve super-chlorination. Recent studies show that many times this is not as effective as Hyper-chlorination which is raising the level of chlorine to 20 parts per million.

These methods may temporarily "burn out" chloramines but will also necessitate the pool being closed for a few days. More than the normal amount of fresh air will also have to be introduced during this process. Shocking the pool can create a whole new set of problems.

Some success has been realized with a non-chlorine shock additive. Adding an Oxidizer (Potassium Peroxy, Monosulphate = brand names Oxykleer or Oxybrite) to the water to convert the available chlorine to free chlorine can release the available chlorine to free chlorine. If this process is done in the evening, swimmers can usually be in the pool the next morning. Fresh air introduction is still important. There are some new enzyme chemicals that say they help chloramines – no positive proven results have yet to be reported.

PREVENTION:

Usually more than one thing needs to be changed to alleviate the problem.
The most common methods are:

1. Change the air circulation system to include more fresh air introduction and better turnover or more efficient closed system circulation and dehumidification.
2. Evaluate the type and brands of chemicals being used to treat the pool water for both chlorine and pH control
3. Evaluate the pool filtration system to see if a filter that filters down to a more effective micron rating (like DE at 4 microns) would help.
4. Check the labels on all cleaning products to make sure they do not contain ammonia or are not nitrogen enriched.
5. Have you staff attempt to get the users of the pool to take showers before entering – this is usually required by state health codes.
6. Consider installing a medium pressure Ultra Violet (UV) water treatment system that cuts down on the amount of chlorine you have to use and also "breaks down" chloramines.
   (*See information at end of this article about UV)*

When does the pool water need to be changed?

That depends on:

1. The size of the pool
2. The water temperature the pool is kept at
3. The bather load
4. The type and brand of chemicals used
5. The type of filter and the turnover rate

In general – the smaller the pool the more frequently the water has to be changed. Hot Tubs in the 300-600 gallon range need to be drained and refilled at least monthly. Many State Dept. of Public Health's require that exact schedule.

Many specialty pools – such as lessons pools or therapy pools in the 1,500 to 5,000 gallon range need to be drained every 3-4 months. The warmer the water and the higher the bather load the more frequent the water needs to be changed.

Larger pools – such as lap pools and competitive pools can actually go years before needing to be drained. Because of the large surface area of these pools exposed to evaporation, new water is constantly being added. In effect the water is always in a state of renewal. I have seen pools with perfect water that have not been drained for 4 years or more. * WARNING draining the pool may cause more problems than it solves because of chloraminated city water that will be used to refill pool.

Some things that can shorten the life of the water and necessitate early draining:

1. Improper chemicals with non-soluble buffers or binders and poorly designed "inert ingredients"
2. Poor quality filtration
3. Continually "shocking" pool to break up chloramines
4. Users not taking showers before entering pool
5. Chlorine generators using salt to produce chlorine.

Problems cannot be ignored. Serious health and safety issues are involved. Everyone who works in an aquatic facility needs to be made aware of the importance of a clean and healthy environment.

"UV or not to be" that is the question…….

Water treatment is almost always the problem when the air is "bad". Improperly balanced chlorinated pools can cause Asthma, according to research from several sources. These findings may explain why swimmers are more prone to exercise educed Asthma than athletes in other sports. "Results show that nitrogen trichloride (produced by high levels of available Chlorine) is a cause of occupational asthma in swimming pool workers like lifeguards and swim instructors," says Dr. K. Thickett of the Occupational Lung Diseases Unit at the Birmingham Heartlands Hospital. In Dr. Thickett's study, each of the subjects either stopped taking inhaled corticosteroids altogether, or their asthma symptoms resolved significantly once they were placed in other environments away from the swimming pools. Dr. Thickett's study was backed up by research from other European and Australian sources.

The problem isn't the chlorine, but what chlorine turns into when combined with organics. The organics are contributed by bathers in the pool in the form of sweat, dander, urine and other organics. The chlorine reacts with the organics and produces nitrogen trichloride, aldehydes, halogenated hydrocarbons, chloroform, trihalomethanes and chloramines. If these sound like dangerous chemicals, they are. During the Olympic Games held in Australia, it was reported that more than one-quarter of the American swim team suffered from some degree of asthma.

Investigators in Belgium have presented research showing that exposure to such chloramines greatly increases permeability of the lung epithelium, a condition associated with smoking cigarettes. In a study presented by Dr. Simone Carbonnelle, of the industrial toxicology and occupational medicine unit at the Catholic University of Louvain in Brussels, 226 otherwise healthy school children, mean age 10, were followed to determine how much time they spent around swimming pools, and the condition of their lung epithelium. The children in Dr. Carbonnelle's study were exposed to air around the school swimming pool for a mean of 1.8 hours per week.
The level of lung permeability would be the equivalent of what she would expect to see in a heavy smoker, according to Dr. Carbonnelle. "These findings suggest that the increasing exposure to the by products of chlorine-based disinfectants used in swimming pools might be an unsuspected risk factor in the rising incidence of childhood asthma and allergic diseases," she said. The variation in lung surfactants persisted whether the children lived in a rural area or in the city, and whether they were from upper income, or less well-off families, she added.

As part of Dr. Thickett's study, three employees of a local public swimming pool who complained of asthma-like symptoms were subjected to chloramine challenge tests in which, in the lab setting, they were exposed to roughly the same amounts of chloramine as they would be exposed at work (i.e., around the swimming pool, close to the surface of the water). Measurements of nitrogen trichloride were taken at 15 points around the pool, 1 m above the surface of the water. When exposed to equivalent amounts of the chemical in the lab, the three subjects all experienced significant reductions in forced expiratory volume in one second (FEV1), and high measurements on their Occupational Asthma Expert System (OASYS) scores, a measurement of asthma and allergy severity.

In the Belgium study, chloramines in the air around the surface of the pool were measured. In addition, three specific proteins were measured in the children: SF-A and SF-B (surfactant A and B) and Clara cell protein 16 (CC16). Surfactant A and B are lipid-protein structures which enhance the bio-physical activity of lungs lessening surface tension in the lung epithelium and preventing the collapse of the alveoli at the end of expiration. Anything that impairs the function of these surfactants will clearly impair lung function as well, because it makes the epithelium more permeable.

Both of these studies were concerned with chlorine byproducts in the air above swimming pools. Studies in the United States, Canada and Norway have linked chlorine byproducts in ordinary tap water to higher risks of miscarriages and stillbirths in pregnant women and increased incidences of bladder and colon cancer. Of disturbing news for swimming pool patrons are studies that show much higher levels of these chemicals are found in swimmers. And the highest levels are found in the most active swimmers.

The heightened risk is linked to exposure to a contaminant found in chlorinated water called trihalomethanes (THMs) which forms when chlorine reacts with organic material. THMs are a widely recognized carcinogen. While regulation changes in Canada and the United States have put tighter restrictions on the levels of THMs allowed in tap water, no such regulations exist for swimming pool water.
This is in spite of a study that found a 1 hour swim resulted in a chloroform dose 141 times the dose from a 10 minute shower and 93 times greater than exposure by ingestion of tap water.

Recent Studies on THMs in tap water include:

- A study by California health department investigators Kirsten Waller and Shanna Swann examined the records of 5,144 pregnant women from the Fontana, Santa Clara and Walnut Creek areas. They reported a 15.7% higher chance of miscarriage among women who drank 5 or more glasses of chlorinated water per day.
- A Canadian study reports that women who drink tap water containing high levels of trihalomethanes are twice as likely to have stillbirths. This Dalhousie University study reported that pregnant women increase their risk the more they drink or bathe in water containing the compounds. This study was reported in the scientific journal Epidemiology.

- A Norwegian study of 141,000 births over a three-year period found a fourteen percent increased risk of birth defects in areas with chlorinated water.

Despite these studies on swimming pool patrons, most swimming pool managers are probably unaware that they are exposing their patrons to THMs. This problem is not widely known and for the most part is ignored by the media.

In swimming pools, the most obvious and instant signs of high exposure to these chemicals is red eyes, rashes and other skin irritations or problems. And the highest exposure would appear to be for athletes and other swimmers who exert themselves physically in the water. Researchers report a mean chloroform uptake of 25.8 [micro]g/h for a swimmer at rest and 176.8 [micro]g/h) after 1 hour swimming.

Other studies note that inhalation is an important route of exposure and the uptake through this route is affected by various factors including the number of swimmers, turbulence, and breathing rate. Which means that for elite athletes, the risk of exposure at water level is significantly higher than for that of a casual swimmer. And in both cases, the dosages of THMs far exceed what is considered allowable by merely drinking a glass of chlorinated tap water.

While the incidence of miscarriages and stillbirths is in itself cause for concern, other problems have been identified. Bladder cancer has been linked to chlorinated drinking water in an average of ten out of eleven studies. One of the studies in Ontario, conducted with funding from Health Canada, found that fourteen to sixteen percent of bladder cancers in Ontario showed a direct correlation to drinking water containing high levels of chlorine by-products. Chlorinated water has been linked to colon and rectal cancers in the studies, but the occurrences were not as common as those for bladder cancer.

Solutions?

Dr. John Marshall, of the Pure Water Association, an American consumer group campaigning for safer drinking water, states: "It shows we should be paying more attention to the chemicals we put in our water and we should be looking for other alternatives to high levels of chlorination." There are options that are safe, and non-toxic, such as treating water with ultra violet light.

With medium pressure Ultra Violet systems there is a higher initial capital cost to the swimming pool compared to just chlorine feeders. However, over the life of the pool Ultraviolet technologies reduce the on-going operating and maintenance costs. These costs can be significant. Chlorine is famous for destroying pool infrastructures, rusting out ventilation systems and destroying pool liners and coatings etc. UV poses no such problems. The UV pool will be much cleaner, which means dirt, grease, oils, organics and other materials will wind up in the filter system much faster than with highly chlorinated systems. If the filter and strainer maintenance is not stepped up accordingly, the pool recirculating system will slow down and the pool will actually look dirtier than with Chlorine. However, proper maintenance of the filter system will solve this problem.

Part of the problem in adopting UV is that many engineers, architects, pool builders and designers are not all that familiar with the technology. Since our engineering, architectural and other technical training have all been geared to Chlorine, it takes re-education to now apply UV. Many people in these industries are reluctant to "shift gears" and take the time to educate themselves about the proper application of UV.

Chlorine is a complex man-made chemical that found original use in the infamous "mustard gas" of the First World War. Chlorine is also an entrenched technology. It has been widely used in North America and was first adopted at the turn of the century. It is still the reigning champion of disinfection and has many supporters in the chemical and swimming pool industries.

It is the organics that cause problems when combined with chlorine. By reducing the organic load, the Europeans keep the chloramines (the cancer causing substances) at a very low level. In European swimming pool systems, the same thought process prevails. In German DIN standards, for example, the strategy is to use a large "surge pool" that the public doesn't even see to apply Ozone or disinfection chemicals. The disinfection byproducts are then removed by various filtration processes prior to the water being returned to the pool with a slight dose of chlorine. Under these standards, swimming pool water is essentially treated to drinking water standards.

The North American model developed under much different circumstances than the European. In North America, chemicals were adopted wholeheartedly around the turn of the century as the answer to the larger, more expensive European models of water treatment. Engineers here found they could build water treatment plants and swimming pools at greatly reduced capital costs if they used what was then considered miraculous chemicals to treat water. And, for the most part, the systems did what they were designed to do and that was to kill micro-organisms that could lead to sickness and death. What they didn't anticipate was that chemicals like chlorine would have very serious byproducts that become health hazards themselves.

However, in North America we are now stuck with swimming pools that in Europe would be considered "surge tanks". The challenge is to evolve UV technology that can retrofit a large installed base of swimming pools in an economical manner. These systems are now starting to appear in the marketplace in increasing numbers and the success rate of positive results is amazing.

Once pool owners add medium pressure UV, they realize that they no longer have to put up with red eye, rashes, unbreathable air and the health consequences of over chlorinated pools.
As the technology becomes more prevalent, expect to see more expertise at the local pool builder or pool maintenance companies. However, many of these companies rely on repeat sales of chemicals. These companies are likely to be highly resistant to UV systems as after-sales revenues will drop. However, for pool maintenance companies that are being paid to keep pools clean, UV is great. They should spend less time maintaining pools and the pools will be cleaner and the water more appealing. In the future, expect UV prices to drop slightly as more consumers become educated, demand for systems will definitely increase.

UV does not replace chlorine but allows you to run a lesser residual chlorine reading and allows the chlorine to be used 100% for disinfesting rather than go into combination with other elements. Your State department of Public Health will have a copy of your states regulations and limitations for using UV in commercial pool applications. Each state may have different codes and getting them to lower their required minimum chlorine levels can be very challenging.

What is ultraviolet or UV ?
Ultraviolet light is part of the light spectrum, which is classified into three wavelength ranges:

- UV-C, from 100 nanometers (nm) to 280 nm
- UV-B, from 280 nm to 315 nm
- UV-A, from 315 nm to 400 nm.

UV-C light is germicidal - i.e., it deactivates the DNA of bacteria, viruses and other pathogens and thus destroys their ability to multiply and cause disease.
It also breaks down chloramines that develop in indoor swimming pool water.

Specifically, UV-C light causes damage to the nucleic acid of microorganisms by forming covalent bonds between certain adjacent bases in the DNA. The formation of such bonds prevent the DNA from being unzipped for replication, and the organism is unable to reproduce. In fact, when the organism tries to replicate, it dies.

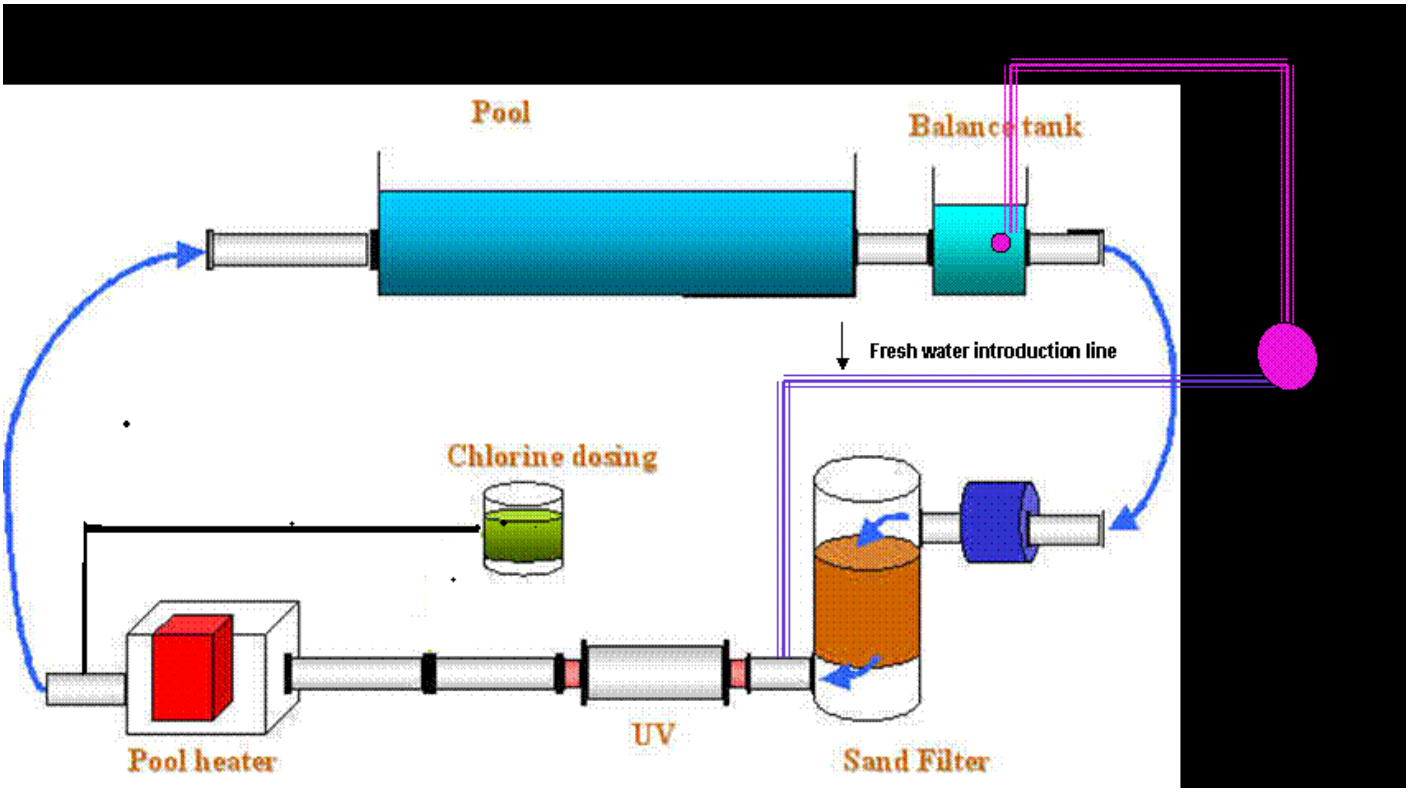
Ultraviolet technology is a non-chemical approach to assist disinfection. In this method of disinfection, nothing is added to the pool water except chlorine and pH control chemicals.
This makes this process simple, inexpensive and requires very low maintenance.
Ultraviolet purifiers utilize germicidal lamps that are designed and calculated to produce a certain dosage of ultraviolet (usually at least 16,000 microwatt seconds per square centimeter but many units actually have a much higher dosage.) The principle of design is based on a product of time and intensity - they must have a certain amount of both for a successful design.

WATER APPLICATIONS
- under sink installs & water vending machines
- aircraft, boats & recreational vehicles
- water wells & water cisterns
- swimming pool & hot tubs
- farms, ranches & trailer parks
- schools & hotels
- aquarium, hatcheries and nurseries

How do ultraviolet purifiers work - Short wave pressure mercury vapor tubes that produce ultraviolet wavelengths are installed in a water tight chamber. The UV system is installed after the pool filter and the return water to the pool is circulated 100% through the tube. Approximately 95% of the ultraviolet energy emitted is at the mercury resonance line of 254 nanometers. This wavelength is in the region of maximum germicidal effectiveness and is highly lethal to virus, bacteria and mold spores. Therefore, the water or air that passes through the chamber is exposed to the germicidal UV light and the genetic material of the micro-organism is deactivated, which prevents them from reproducing.

The CDC and others are currently conducting test for the effectiveness of UV in killing “germs” and breaking down chloramines. There are still discussions whether low pressure UV is as effective and efficient as medium pressure. Bottom line is that the initial UV test results are good and many pools that have installed UV have seen a 100% turn around in their air and water quality almost immediately. The Facilities Department of USA Swimming strongly recommends that all indoor pools have medium pressure 100% flow through UV installed.

The FDD of USA-S has identified 3 preferred providers for UV systems. You can contact us for information about these manufacturers and distributors. We have also developed a 20 minute CD power point with audio called the Safe-WAY (Water Air & You).
E-mail mnelson@usaswimming.org for information.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
POOL AREA - Daily procedures																															
Lights on																															
Locker & Bath room check - toilet paper, towels, general cleanliness																															
Benches & Chairs wiped off																															
Uncover pool – check covers & rollers																															
Check pools -clarity and bottom clean																															
Test water–pH +CL x2 and record AM																															
Test water–pH +CL x2 and record PM																															
Clocks on correct time																															
Ck calendar for daily events /clients																															
POOL FILTER ROOM – Daily procd																															
Check pumps and filters for leaks or unusual noises																															
Check chemical containers																															
Ck area of room for proper storage																															
Check for wet floor																															
LAND AREA – Daily procedures																															
Lights on																															
Pick up rooms																															
Access area check																															
Check supplies																															
POOL AREA – Daily routine																															
Greet members by name and interact																															
Encourage members																															
Maintain safety of member and pool																															
Reports attendance and maintenance																															
Distribute information																															
Cover and uncover pools as needed																															
Clean equip. spray with disinfectant																															
Safety check on all equipment																															
Report comments or concerns – in writing - to supervisor																															
Hosing of decks & floors																															
Weekly /Monthly																															
Pool cover cleaning																															
Rust inhibitors for any metal																															
Clean metal – silicone																															
Check gutters for build up																															
Check pool Vac equipment																															
Check test kit for chemical testers																															
Disinfect decks and floors																															
Check written reports																															
Closing Procedures - Daily																															
Bathroom Ck - toilet paper, towels																															
Benches wipe off																															
Check pools																															
Hook up Vac - cover pools																															
Towels supply																															
Lights off																															
Lock area																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

For more information please contact:

USA Swimming Facilities Development Department 1 Olympic Plaza Colorado Springs, CO 80909 719-866-3522 mnelson@usaswimming.org