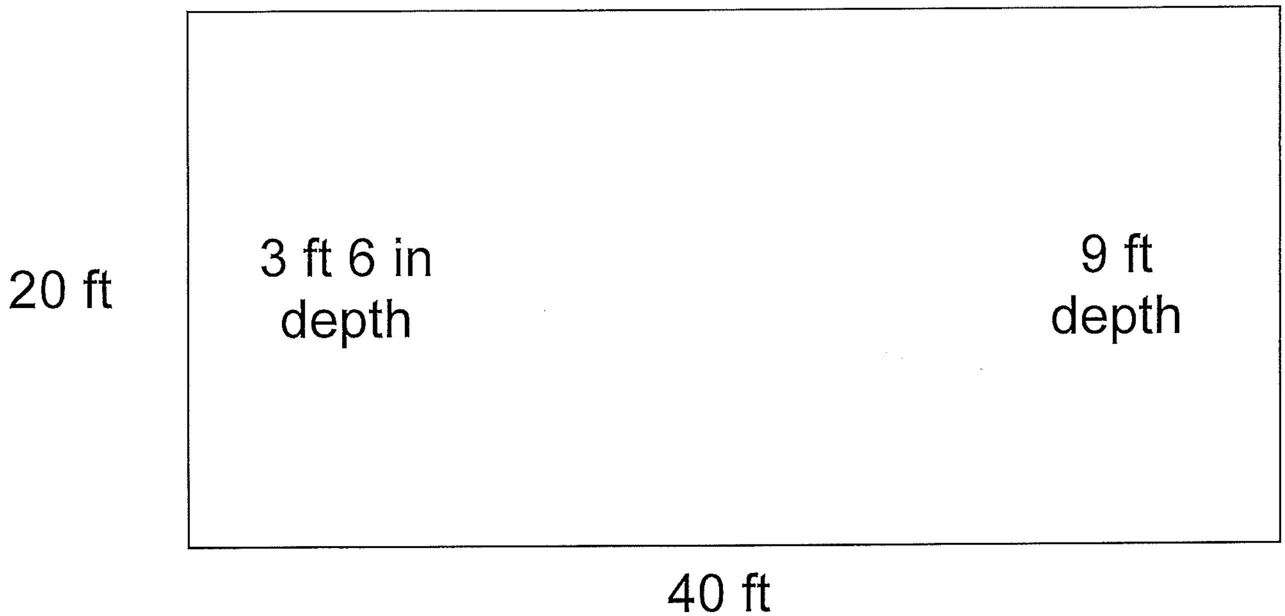
Supplemental Packet

Trade/Chemical Name Chart

Trade Name	Chemical Name
Acid Magic	Hydrochloric Acid with Buffer
Alkalinity Increaser	Sodium Bicarbonate
Bromine Tabs (1")	Bromo-chloro-dimethlhydantoin
Cal Hypo (1",3" & Granular) Super Shock	Calcium Hypochlorite
Chlorine (Liquid)	Sodium Hypochlorite
Crystal Clear	Liquid Sodium Bisulfate
D.E. Powder	Diatomaceous Earth
Dichlor (Granular)	Dichlor Stabilized Granular Dichloro-s-triazinetrione
Fast Shock	Lithium Hypochlorite
Filter Cleaner/Stain Remover	Sodium Hydrosulfite
Hardness Increaser	Calcium Chloride
Muriatic Acid	Hydrochloric Acid
Chlorine Neutralizer/Dechlor	Sodium Thiosulfate
Non-Chlorine Shock	Oxone Monopersulfate
pH Increaser/Soda Ash	Sodium Carbonate
pH Decreaser Alkalinity Decreaser	Sodium Bisulfate
Safe Step	Ice Melt
Stabilizer Conditioner	Cyanuric Acid
Tri-Chlor (Tablets 1"/3")	Chlorine & Cyanuric Acid Trichloro-s-triazinetrione
TSP	Tri-Sodium Phosphate

Volume Example for a Typical Hotel/Apt. Pool



Formula:
L x W x (Average Depth (AD)) x 7.5 = Volume

Step 1:
Depth (Average):
3ft 6in + 9ft = 3.5 + 9 = 12.5ft
÷ 2 = 6.25ft (Average Depth for pool)

Step 2:
Formula L x W x AD x 7.5
40 x 20 x 6.25 x 7.5 = Total Volume

Step 3:
Total Volume = 37,500 Gallons

How many pounds of Calcium Hypochlorite
(Dry powder chlorine)
are needed to **breakpoint chlorinate?**
(Remove Chloramines)
in a 50,000 gallon pool.

FC = 1.0 ppm (Free Chlorine)   TC = 2.5 ppm (Total Chlorine)

STEP 1

A: TC − FC = CC
2.5 − 1.0 = 1.5

B: CC x 10 = Breakpoint
1.5 x 10 = 15.0

C: Breakpoint − FC = Desired Change
15.0 − 1.0 = 14.0

STEP 2

Amount of Chemical	Actual Pool Volume in Gallons	Desired Chemical Change	Total
↓	50,000	14	↓
	÷ 10,000	÷ 1ppm	
2oz	X 5	X 14	= 140oz

140 oz ÷16 oz/lb = **8.75 pounds**

How many gallons of Sodium Hypochlorite (liquid chlorine) are needed to **breakpoint super-chlorinate** in a 180,000 gallon pool?

FC = .7 ppm (Free Chlorine) TC = 1.5 ppm (Total Chlorine)

STEP 1

A: TC − FC = CC
1.5 − .7 = .8

B: CC x 10 = Breakpoint
.8 x 10 = 8.0

C: Breakpoint − FC = Desired Change
8.0 − .7 = 7.3

STEP 2

Amount of Chemical	Actual Pool Volume in Gallons	Desired Chemical Change	Total
↓	180,000		↓
↓	÷		↓
10.7 fl.oz.	X		….98oz

140… = 11 Gallons

Calcium Hardness Formula

- The Pool Volume = 95,000 gallons
- Adjust or increase the Calcium Hardness from 80 ppm to 300 ppm
- We will Use Calcium Chloride (100%) (see pg 260 in handbook)

Amount of Chemical	Pool Volume	Change	Total
	95,000 gal	220 ppm	
	÷ 10,000 gal	÷ 10 ppm	
0.9 pounds X	9.5 X	22 =	188.1 pounds

- The Pool Volume = 60,000 gallons
- Adjust or increase the Stabilizer from 10 ppm to 30 ppm
- We will Use Cyanuric Acid (see pg 260 in handbook)

Amount of Chemical		Pool Volume		Change		Amount of Chemical
		60,000 gal		20 ppm		
		÷ 10,000 gal		÷ 10 ppm		
13 ounces	X	6	X	2	=	156 ounces

Ounces ÷ 16 = Pounds

156 Ounces ÷ 16 = 9.75 Pounds

Property Name -

Horizon Commercial Pool Supply
1-800-969-0454 651-917-3075 Local 651-917-3087 fax
Online Calculators at:
www.horizonpoolsupply.com

Pool Gallons 10,000

Liquid Chlorine — *Horizon Liquified Chlorinator - Sodium Hypochlorite*

Increase by PPM	1	2	3	4	5	6	7	8	9	10
Fluid Ounces	13.0	26.0	39.0	52.0	65.0	78.0	91.0	104.0	117.0	130.0
Cups	1.6	3.3	4.9	6.5	8.1	9.8	11.4	13.0	14.6	16.3
Gallons	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

Granular Chlorine — *Cal Hypo Granular - Calcium Hypochlorite*

Increase by PPM	1	2	3	4	5	6	7	8	9	10
Ounces by Weight	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0
Pounds	0.1	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.3

Neutralize Chlorine — *Chlorine Neutralizer - Sodium Thiosulfate*

Decrease by PPM	1	2	3	4	5	6	7	8	9	10
Ounces by Weight	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Pounds	0.1	0.1	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6

Increase Alkalinity — *Alkalinity Increaser - Sodium Bicarbonate*

Increase by PPM	10	20	30	40	50	60	70	80	90	100
Pounds	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0

Increase Calcium Hardness — *Hardness Increaser - Calcium Chloride*

Increase by PPM	10	20	30	40	50	60	70	80	90	100
Pounds	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0

Increase Cyanuric Acid — *Stabilizer Conditioner - Cyanuric Acid*

Increase by PPM	5	10	15	20	25	30
Ounces by Weight	6.5	13.0	19.5	26.0	32.5	39.0
Pounds	0.4	0.8	1.2	1.6	2.0	2.4

Increase pH — *Soda Ash*

	Ounces by Weight	Pounds
pH 7.2 - 7.4	6.0	0.4
pH 7.0 - 7.2	8.0	0.5
pH 6.6 - 7.0	12.0	0.8

Decrease pH — *pH Decreaser - Sodium Bisulfate (dry)*

	Ounces by Weight	Pounds
pH 7.7 - 7.8	96.0	0.8
pH 7.8 - 8.0	160.0	1.3
pH 8.0 - 8.4	192.0	1.5

Decrease pH

	Acid Magic Fluid Ounces	*Acid Magic* Gallons	*Muriatic Acid* Fluid Ounces	*Muriatic Acid* Gallons	*Crystal Clear pH Decreaser - Liquid Sod. Bisulfate* Fluid Ounces	*Crystal Clear pH Decreaser - Liquid Sod. Bisulfate* Gallons
pH 7.7 - 7.8	12.0	0.1	12.0	0.1	28.0	0.2
pH 7.8 - 8.0	16.0	0.1	16.0	0.1	48.0	0.4
pH 8.0 - 8.4	24.0	0.2	24.0	0.2	58.0	0.5

Body Fluid Contamination Response Log

Person Carrying out Contamination Response			Supervisor on Duty			
Date (mm/dd/yyyy) of Incident Response		Time of Incident Response		Number of People in Water		
Water Feature or Area Contaminated						
Specify Type/Form of Contamination	Formed stool	Diarrhea	Vomit	Blood		
Stabilizer Used in Water?	_____ YES	_____ NO				
Water Quality Measurements	*Taken 6 times during DISINFECTION (once every____ minutes)*					
	Closure	1	2	3	4	Prior to Reopening
Time at Measurements						
Free Residual CHLORINE						
PH						

Date (mm/dd/yyyy) that Water Feature was Reopened		Time that Water Feature was Reopened	
Total Contact Time (Time from when disinfectant reached target level to when disinfectant levels were reduced prior to opening)	**From ______ To ______** **Total Time Lapse ______**		
Remediation Procedure(s) Used and Comments/Notes			

CDC. 2008. MAHC, Policies & Management Annex.

AQUATIC ACCIDENT REPORT

IMPORTANT: This can be used as a legal document. This form must be *Legible*, complete and relevant. Please provide as much information as possible. Submit completed form to immediate supervisor within 24 hours. For serious emergencies, call your supervisor as soon as possible after Accident Report is completed.

Today's Date: ___________ Person Preparing Form ______________________________

Personal Data

Name of injured participant: ______________________
If injured party refuses to provide name, describe his/her physical characteristics:

Daytime Phone: ____________________ Sex: ___M ___ F Age: _____

Status *(circle one)*: Staff Renter/Member Dependent Guest

Address: ____

Accident Witnesses *(put the names and phone numbers of additional witnesses at the bottom of the page).*

1. First and Last Name _________________________ Daytime phone _______________
2. First and Last Name _________________________ Daytime phone _______________

Details of Accident

Date of Accident: ____________ Time ______________a.m./p.m. Aquatic Area __________

Activity ____

How did Injury Occur *(specify events leading to accident/injury). Use additional pages if necessary.*

(Circle One) Collision with obstacle Collision with participant Water Related

Equipment Related Non-Contact Other ______________________

Describe in detail, exactly how the injury occurred (as observed or as reported to you).

Comments made by injured participant *(regarding how injured part feels, what hurts, any complaints).*

Part of Body Injured

(Circle) Ankle Arm Back Ear Elbow Eye Face Finger Foot Groin Hand Head

Hip Knee Leg Mouth Neck Nose Shoulder Toe Torso Wrist Other _________

Describe in Greater Detail: Right Left

Suspected Classification of Injury

(Circle) Drowning Breathing Difficulty Concussion Contusion/Bruise
Dislocation/Break Laceration Strain/Sprain Unknown Other ____________

Does the participant have a history or injury/surgery that may have contributed to the injury? Yes No

If yes, participant reported ____

First Aid Administered by:

Name ____ Daytime Phone # ______________

***Action Taken** (circle all that apply):*

Applied Ice Applied Bandaid/bandage Applied Pressure to Stop Bleeding CPR

Kept immobile Elevated Other ________________

Describe in Greater Detail

Additional Assistance Summoned? Yes No Exact time of call ________________ a.m./p.m.

Ambulance #/Name of company responding ______________________________________

First Responder/Officer & Badge # responding ______________________________________

Person (parent, friend, RA) to be notified if transported to hospital:

First and Last Name * ____________________________________ Phone # ______________

Contact the person immediately after participant is transported.

Signature of Injured Participant

I agree that the information reported on this form is accurate and true.

Signature of Injured Participant (or parent of minor dependent) ______________________ Date __________

Injured participant was ***unable*** to sign this report. Injured participant was ***unwilling*** to sign this report.

Subsequent Action Taken

(Circle One) Left the facility Remained in facility but refrained from participating

Resumed participation of own volition Driven to ____________________ By ______________________

Bloodborne Pathogen Exposure Control

Blood or potentially infectious materials present?	Yes	No
Personal protective equipment (gloves) worn?	Yes	No
If no, did *Exposure Incident* occur?	Yes	No
Biohazardous Waste created?	Yes	No

Disposed of Properly Yes No

Specify what was disposed of and where (e.g., gloves, bandages).

Did participant leave facility before contaminated items could be collected for proper disposal? Yes No

IF 911 was called:

State Health Department Contacted? (Steve Klemm)	**Yes**	**No**	**651.201.4503**
Local Health Department Contacted?	**Yes**	**No**	

Reviewed by: ______________________ **Position:** ______________________ **Date:** ____________

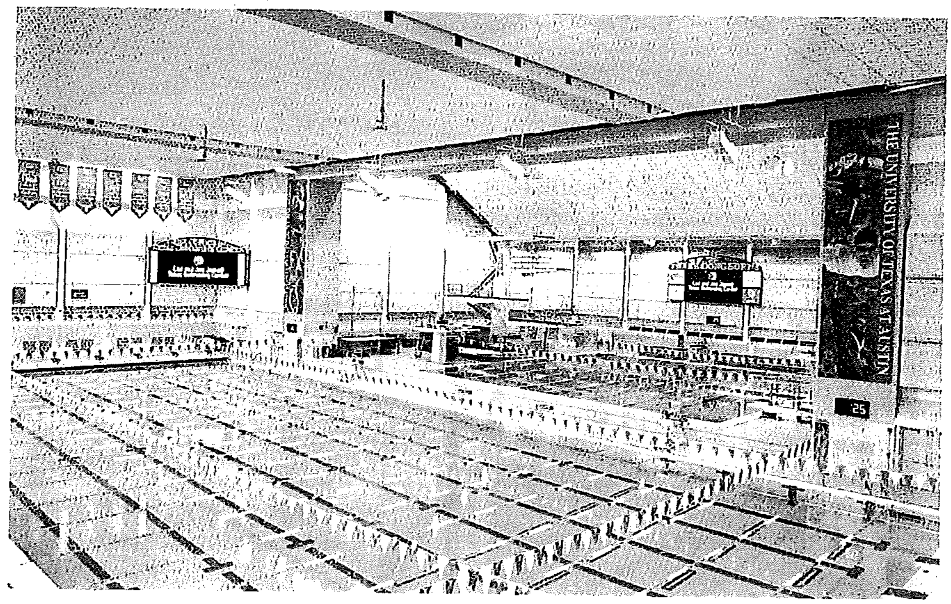
CHARLES LOGAN *is director of the Lee and Joe Jamail Texas Swimming Center, having previously worked at Texas A&M University and municipal aquatic management for the past 25 years. He has served as president of the Texas Public Pool Council, board member of the NRPA Aquatics Branch and currently is serving on the board of the Association of Aquatic Professionals.*

Clearing the Air

A major natatorium renovation incorporates new technologies and old ideas to tackle chloramine issues. Find out what worked — and what didn't.

I remember growing up as a swim team kid in the '60s and '70s. Life seemed a little more simple back then. During public swim time, I'd turn my basket in with my clothes, grab a numbered pin and then was made to shower before entering the pool. Some pools I visited had foot baths, which would take care of any fungi that I might have dragged into the pool.

By 1977, a lot had changed. That's when the Lee and Joe Jamail Texas Swimming Center was built on the campus of the University of Texas at Austin. In the decades since then, even more has changed. And our once state-of-the-art facility fell victim to an issue affecting so many other indoor facilities today: air quality. Changes in the type of chlorine, lack of showering practices, huge increases in bather loads, makeup water with chloramines, and the green movement of reusing and recycling the same air are only some of the reasons for this growing problem.



ONE-TWO PUNCH To fight chloramines, this facility used a combination of new air-handling techniques, such as large fans and air intakes down low where DBPs gather.

So, at the University of Texas, we embarked on a $15 million air-handling renovation that took an approach just as multifaceted as the problem itself — one that incorporated new technologies and old ideas.

The first thing we did was look at attacking the source of the problem. Perhaps bringing some of the old concepts of showering before swimming and signage about urinating in the pools need to be brought back. Encouraging your swim coaches to have bathroom breaks should be instituted. I believe some of those old ideas can be resurrected. For instance, we are bringing back showering and closing the pool for bathroom breaks for regular swim times.

But some of these old methods are impractical. The swimming community has really grown, and swim meets are huge. I've hosted events with more than 2,000 athletes covering a span of three or four days! Convincing all those athletes to go through the showers before warm-ups will never work. Add the fact that their coaches would need to make sure after they've been running around outside between each event that they shower before their next races. It won't happen. Without new ways of dealing with it, the problem of chloramine will arise during large events.

The second thing we did was study how to deal with chloramines when the occasion arises (for example, huge events). First we did a complete 3-D model of our building. Then we used computational fluid dynamics (CFD) computer modeling to show what our air was actually doing. We discovered that the center of the pool wasn't getting any airflow — and that's exactly where chloramines were gathering.

We looked at sucking the contaminated air out of the building through the gutters by installing huge air outtakes in the side of the building and installing vents around the deck. Our CFD modeling showed that in our case, it would not work. We couldn't build a large enough turbine to suck the air across a 50-meter pool. We ended up incorporating some of the latest technologies that proved to work in our CFD modeling — and on a practical basis. Here they are in the order of what I think is most important.

1 We installed medium-pressure UV. Our combined chlorine levels instantly went from a constant .4 ppm to .1 or less. That was immediately noticed by all users. But it did not completely cure the problem. As you know, UV does not carry a residual and only is effective as the water passes through the light.

2 We installed new, custom-built air handlers. These units were designed with the capacity to bring in 100 percent outside air. I believe this is one of the most important things we did to improve air quality. These units were designed to be completely run by a computerized program that could purge all existing air in the building in less than an hour. This was by far the most expensive part of our renovations — $9 million to be exact. Not everyone can afford new systems, but I would encourage all to go back and make sure their outside air dampers can be opened up on a regular basis. Our previous system had plywood covering the outside air dampers because the conditioning of the outside air was not energy-minded. You can't afford to not open the dampers.

3 We installed an air distribution system and large fans with air intakes strategically placed according to what our CFD models showed us would work.

4 We installed a carbon water filter on our automatic fill lines. During large meets we lose a lot of water. Our makeup water has high levels of chloramines. Combine a huge bather load and makeup water with chloramines, and you can see where I'm going. This is a relatively inexpensive and easy fix if you have the same problem.

5 We incorporated carbon gas-phase technology. This involved installing carbon filter pellets on our air handlers as pre-filters. This technology is used in hospitals. Our testing is inconclusive at this point, but this was a relatively minor cost to the overall project, so we decided to try it out.

In the past, I experimented with chloramine removing water filter media, with poor results. Some of the new technologies available include using moss as a means of removing chloramines. I'm interested in looking at these new technologies and am open to them. But even with the new technologies available today, some of the best technologies and practices are the ones from our past.

GET **MORE** For more pictures illustrating the technology used in this renovation, go to **aquaticsintl.com**

Circle 17 on Postage-Free Card

Circle 43 on Postage-Free Card

Circle 36 on Postage-Free Card

Survey Finds Commercial Pool Problems

By Nate Traylor To summarize the findings of a recently published survey: Operators need to step up their efforts to ensure pools are safe.

"For those in the aquatics industry, [this is] eye-opening information that is both sobering and full of opportunity," said Frank Schiffman, senior market manager for Axiall Corp. in Atlanta, the company that funded the study.

"In particular, if you're a pool operator, you'll certainly want to know what health inspectors are looking for, commonly cited deficiencies, and how to keep your facility in compliance year 'round."

The study, which was conducted by the National Association of County & City Health Officials, polled local health departments to determine which violations feet-in-the-street inspectors see the most.

The findings shed light on the frequency, duration and causes of pool closures. Seventy-five percent of respondents said they shut down a pool within the past two years. The reasons are as follows:

- Low sanitizing levels (90 percent)
- pH imbalance (61 percent)
- High stabilizer level (14 percent)
- Suspected or actual RWI outbreak (11 percent)

Of those pools that were closed because of a potential outbreak, it was an even split between those that were out of commission for one and two days. Most other violations (cloudiness, low sanitizing levels, poor record keeping, etc.) resulted in a one-day closure.

The survey also found that nearly 70 percent of the nation's health inspectors hold credentials as a Certified Pool/Spa Operator or Aquatic Facility Operator, and 80 percent have received on-the-job training. This is in spite of many health department cutbacks on training resources.

"That gave them the validity ... to judge the facilities they're visiting," Schiffman said. The findings were unveiled at the World Aquatic Health Conference in Portland, Ore., in October.

The survey indicates that the majority of ordinance enforcers also are up to speed on the Virginia Graeme Baker Pool and Spa Safety Act. Nearly 80 percent say they always, or most of the time, check drain covers and fittings for compliance.

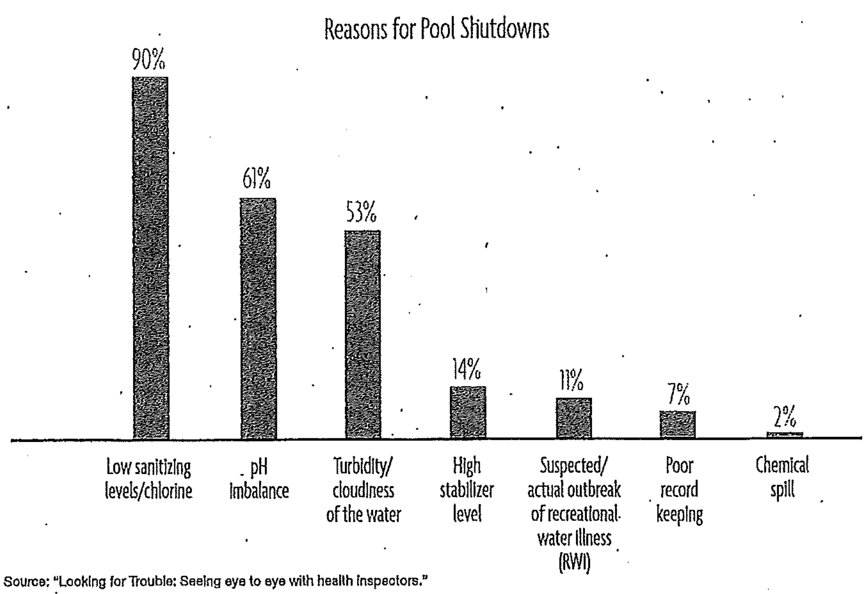
The Model Aquatic Health Code, however, appears to be a blind spot. Half of respondents said they never heard of it or were only vaguely familiar with it.

As for chemistry, there's room for improvement. While nearly 100 percent indicated that they always test pH levels, free and total chlorine, and turbidity, they're not on the same page when it comes to other water-balancing measures. Less than half make a practice of checking stabilizer levels and 40 percent never check the saturation index. Another 46 percent rarely check chemical feeders to ensure they're using the proper chemical.

The survey also asked them to gauge how knowledgeable they perceive pool operators to be. The results showed that there are sectors of the industry that could use some more education. More than 40 percent of homeowners associations, apartment complexes and hotels/motels were identified as facilities where managers have limited knowledge of water and equipment maintenance. These properties also were singled out as having the most staff turnover. It's perhaps no coincidence then that these pools rack up the most violations.

In contrast, pools at schools and universities are a bright spot. Operators at these facilities are the most knowledgeable and can be credited with maintaining the safest pools.

Schiffman hopes the findings will inspire inspectors and operators alike to become "agents of change," and the report outlines some common-sense recommendations. For the complete report, visit *www.LookingForTroubleStudy.com.*



Source: "Looking for Trouble: Seeing eye to eye with health inspectors."

CYA Revisited

RE: Aquatics International, April 2013, article titled, "Is CYA Out on the Inside?'

Kent Williams and I are compelled to respond to the article in *AI* concerning cyanuric acid. We have focused on this topic for more than two dozen years and have clearly done more research on this subject than anyone in the industry.

Much of the article's information concerning "stabilizer, conditioner and cyanuric acid" was accurate. But there are several important points that must be made to further understand and clarify just what the effects of this controversial compound are on the work value of chlorination — and to establish that cyanuric acid is, without a doubt, inappropriate for use for indoor swimming pools.

First of all, the very descriptive name used for cyanuric acid (CYA) is "stabilizer." This more than anything else describes just what CYA does to the hypochlorous acid (HOCl) compound we want and need in our aquatics facility water to handle those two critical jobs — disinfection and oxidation. It is imperative we understand that HOCl is a very effective sanitizer and oxidizer simply because it is unstable!

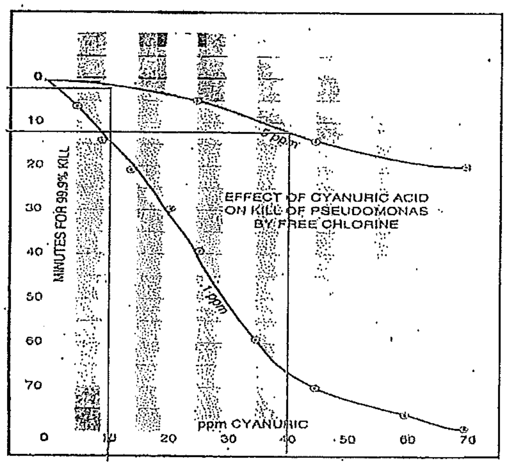
A quick review of basic chlorine chemistry reveals that HOCl is the compound that is produced by adding various chlorine sources from gas chlorine, sodium hypochlorite (liquid chlorine or bleach) or calcium hypochlorite (dry chlorine) to our water. HOCl is the active, "unstable" chlorine compound that disinfects (killing bacteria, viruses and protozoan cysts) and oxidizes (destroying organic compounds created from sweat, saliva, urine and more). However, HOCl, once combined with CYA, becomes a new compound that is "much more stable than HOCl," and the "activity" potential is slowed measurably.

What are the results?

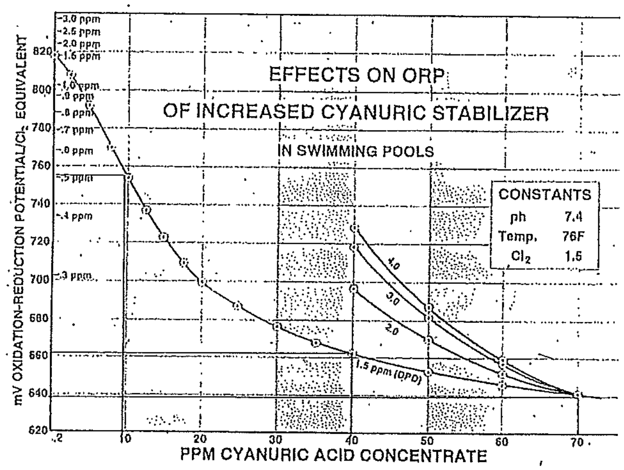
Look at these two specific areas of chemical activity as discussed in the National Recreation and Park Association's *Aquatic Facility Operator Manual*, which contains a full chapter on stabilization.

First, let's look at the CYA effects on bacteria kill times. The first graph illustrates the effect of increasing CYA on the kill time of *pseudomonas* by HOCl. Notice that with no CYA present, the kill time is in seconds. Disturbingly, while dosing the water with only 10 ppm of CYA, we see the kill time slowed to nearly two minutes. Even more alarming, when CYA concentrations reach 40 ppm, the kill time slows to more than 12 minutes! So the "bugs" eventually do "die," but we certainly don't want them swimming laps in the meantime.

Second, let's examine the effects of CYA on oxidation. This graph illustrates the dramatic effect of CYA on the oxidation process. Examine the actual oxidation reduction potential (a millivolt measurement of the water's ability to oxidize, often referred to as the "work value" of the chlorine), and the corresponding ppm (the quantitative or how-much measurement) equivalent. With zero CYA, at a ppm residual of 1.5 ppm, the ORP is near 820. Yet, with only 10 ppm of CYA, the ORP drops to 755 mV with an equivalent ppm "work value" of just over 0.5 ppm. At a 40 ppm CYA concentration, the ORP drops to just over 660 mV (which is just barely over the World Health Organization's ORP minimum of 650 mV for tolerable disinfection) and the equivalent ppm work value of around 0.25.



Pseudomonas kill



Effects of Cyanuric Stabilizer.

So what does it all mean? To simply sum it up, increasing CYA significantly decreases the chlorine's ability to sanitize and oxidize. But does it have value?

With all that said, CYA does have a place in outdoor pools because it significantly decreases the degradation of "chlorine" (HOCl) by ultraviolet light from the sun; however, the greater the organic loading, the less CYA should be used. CYA is a trade-off for longevity (something that shows up on the test kit reading) for "work value" (that which we want and need to be happening in the pool all the time).

CYA and stabilized chlorine should never be used in indoor pools unless, for some reason, there is no other chlorine compound available that day.

In simple, emphatic words, cyanuric acid products have *no place* in indoor pools and should be used with careful discretion on outdoor pools.

Kent Williams, Executive Director, Professional Pool Operators of America; industry consultant; AFO instructor-trainer; author, *Aquatic Facility Operator Manual*

Rich Young, President, Aquatic Commercial Consulting; Technical Adviser; Professional Pool Operators of America; managing editor, 6th Edition, *Aquatic Facility Operator Manual*

READER FEEDBACK

Letters may be edited for clarity and space. Writers' opinions are theirs alone. Send to *Aquatics International*, Attn. Editor, 6222 Wilshire Blvd., Ste. 600, Los Angeles, CA 90048. Emails go to *etaylor@hanleywood.com.* Please include your name, title, company, city and state, and the issue in question.

Zach Hansen

Hansen works for BioLab, a Chemtura company, as a Technical Services Engineer. He has a B.S. in Chemical Engineering from Auburn University, and has spent the last three years with BioLab on new product commercialization and development.

A bromine-sanitized pool needs to be handled with some chemical know-how – but the rewards can be worth it

Sanitation with Brominating Products

Brominated pools tend to exhibit different characteristics than those of pools using traditional chlorine sanitation. Pool operators need to know the nuances of working with bromine in order to maximize oxidizer efficiency, improve the overall swimmer experience, and minimize the associated maintenance.

No more breakpoint

One advantage bromine has over more traditional programs is that it retains active efficiency after reacting with nitrogenous swimmer wastes. Unlike chloramines, bromamines are disinfectants with activity that rivals that of either free chlorine or free bromine. In addition, bromamines do not produce the noxious odors and associated eye and skin irritation attributed to chloramines. Therefore, "breakpoint" sanitation is unnecessary in bromine pools, as bromamines maintain oxidizing activity in the water while retaining aesthetically pleasing qualities.

Frequent oxidation

Though bromamines retain oxidizing activity in the water, and do not produce the infamous "chlorine" odors associated with chloramines, frequent oxidation for a bromine pool is still important. There are two reasons for this:

First, supplemental oxidation facilitates the regeneration process of the bromide ion (Br^-). Once spent by oxidizing organic material or inactivating microorganisms, the majority of active bromine reverts to bromide. This regenerative process is unique to bromine in typical swimming pool water, and is how spent bromine is reactivated into its disinfecting form (OBr^-).

Therefore, frequent oxidation by either a chlorine or a non-chlorine shock such as potassium monopersulfate is necessary to convert the bromide.

Second, oxidation is still required to break down some of the more complex organic wastes introduced by bathers. Generally, bromine is less powerful than some of its oxidizer counterparts, so it's important that a user continue to shock frequently to rid the water of organic wastes that can exhaust sanitizer and give the water a dull appearance.

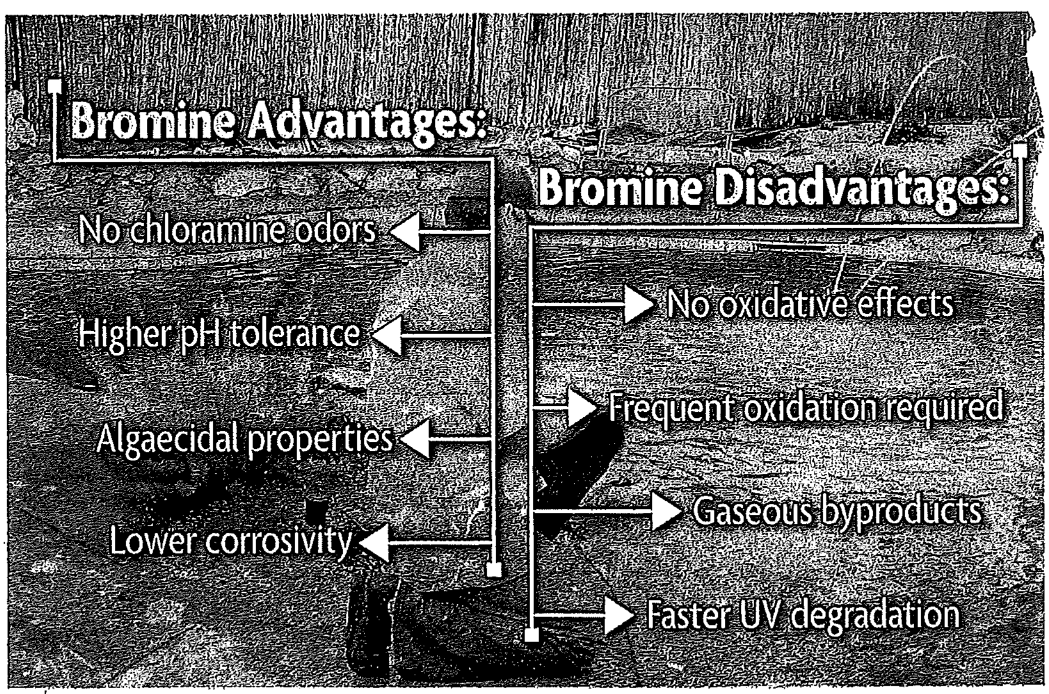
Higher pH tolerance

Bromine dissociates at a higher pH range than chlorine. What this means is that it remains in its active form at higher pH, yielding nearly twice the active efficiency of chlorine at a pH of 7.5, and more than two and a half times the active efficiency at a pH of 7.8.

This is one reason why bromine is more common in spas, due to the natural tendency of spas to operate at a higher pH level as a result of the volatility of carbon dioxide when running the jets.

Fighting algae

In addition to its oxidative properties, bromine exhibits superior algaecidal characteristics. Studies have documented that free chlorine can behave as an algaestat at



a concentration of 0.2 ppm, meaning that it will control algae and prevent growth. However, bromine behaves as an algaecide at a concentration of 0.2 ppm, meaning that it can kill algae to reduce the overall algal population.

Due to these algaecidal properties, bromine pools that have recurring issues of resistant or mustard algae typically operate more efficiently and with less trouble through a full season. It's a helpful option for those customers who are having difficulty eliminating their algae issues.

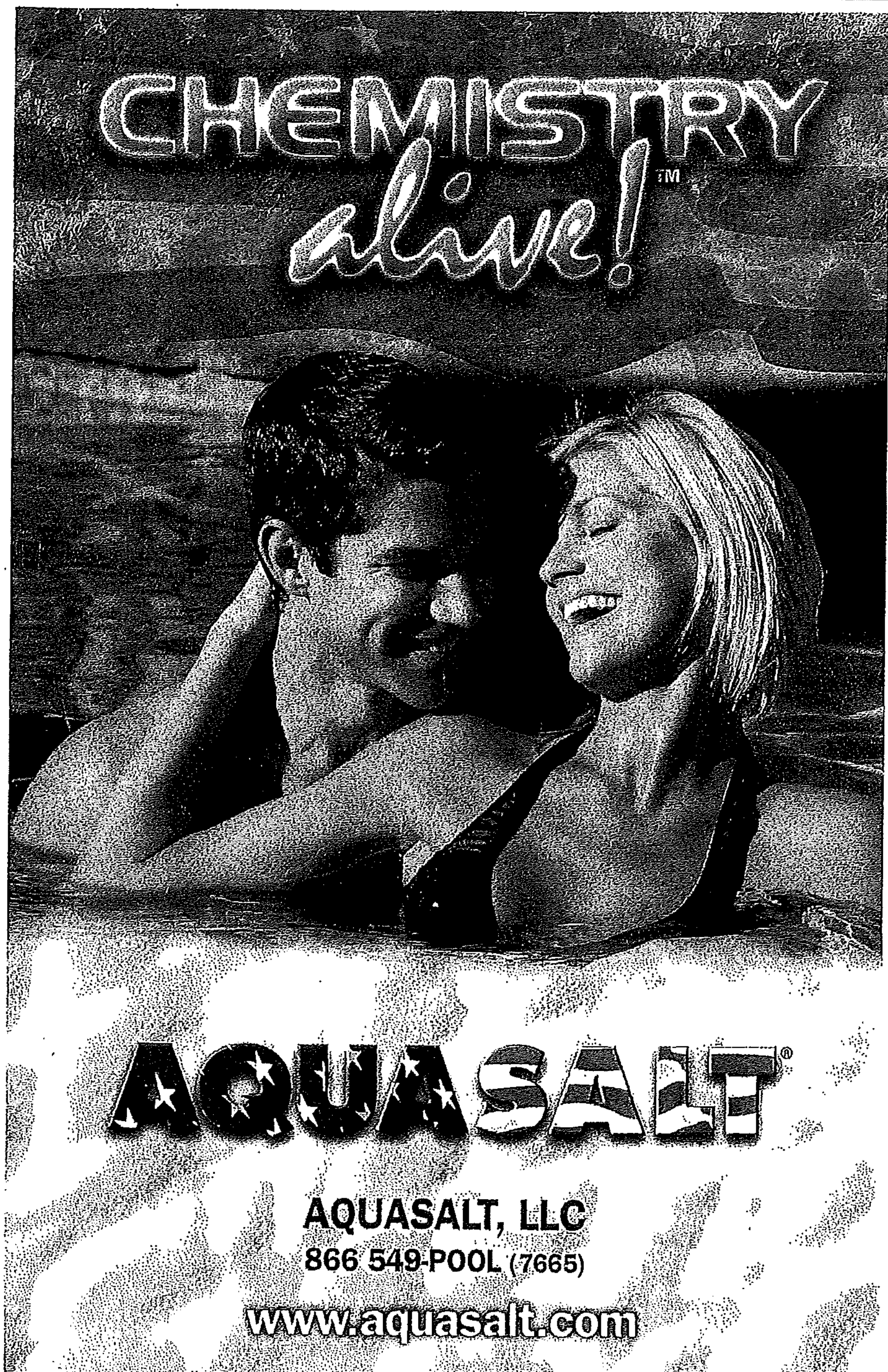
Indoor pools

Bromine is a great option for indoor pools due to the activity and volatility resistance of the bromamine byproducts. The reason bromine pools tend to have reduced odor is due to the lower vapor pressure properties of bromamines. The benefits of this behavior include reduced respiratory irritation to swimmers and less corrosivity to the ventilation system.

However, ventilation systems are still critically important for indoor pools, even ones using bromine. Ventilation systems manage indoor humidity to help limit heat loss from the pool. They also serve as an exhaust for other gasses that volatilize due to the oxidation process of organic wastes by supplemental oxidation.

Outdoor pools

Since bromine cannot be stabilized against the degrading effects of certain bands of UV light, as chlorine can, it has typically been discounted for use in outdoor pools. However, there are methods for managing bromine to mitigate these degrading effects of UV.



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Bromine pools tend to have reduced odor due to the lower vapor pressure properties of bromamines.

Implementation of a continual feed system helps users manage their bromine degradation. Studies have shown that operating a pool at the lower end of the recommended sanitizer range reduces the amount of bromine subject to degradation: The less bromine you keep in the pool, the less is degraded by sunlight.

The half life of bromine is approximately one hour, which means that it will lose about half its oxidizing strength for every hour it is exposed to external sunlight. Therefore, a pool operating at 3 ppm will lose 1.5 ppm of bromine; as opposed to a pool operating at 5 ppm, which will lose 2.5 ppm of bromine over the same 60-minute time period.

Adjusting your feeder to maintain the lower end of the range will minimize the amount of bromine that feeds into the pool. In addition, weekly feeder top-off practices have resulted in a high rate of success. Keeping a full feeder facilitates a more constant feed rate; as tablets erode, the amount of bromine fed to the pool is reduced. Maintaining a full feeder gives an operator greater control over the pool and thus allows for a minimal loss of sanitizer to UV degradation.

Balance is important for swimming pools, whether it's proper water balance to protect the swimmers, surface and equipment; or balancing the benefits of pleasant swimming experiences and easy maintenance against the costs. ■