



THE VERDICT IS IN

ON CYA STABILIZED CHLORINE PRODUCTS

ing on chlorine use and cost. Trichlor, which contains both a chlorinating agent and CYA typically comes in tablet or stick form for use in an erosion feeder for small- to medium-sized public or commercial pools and spas and provides chlorination and UV stabilization in a single application.

The CDC studied the impact of various levels of CYA on chlorination efficacy for decontamination of water infested with Crypto. They determined that too much CYA negatively affects oxidation reduction potential (ORP) and the rate of kill for Crypto.

continued on Page 2

New data published by the Centers for Disease Control and Prevention (CDC) puts a long-standing, hotly debated argument to rest.

*Using cyanuric acid (CYA) stabilized chlorine products (ie., trichlor) **may no longer be a practical way to chlorinate your commercial or public pool or spa.***

If you have been using chlorinated isocyanurates such as trichloroisocyanurate and dichloroisocyanurate, known respectively as trichlor and dichlor, to chlorinate your commercial or public pool, spa or other water venue, you may consider adopting an alternative chlorination

method. What had long been considered a modest level of CYA stabilizer has now been shown by the CDC to inhibit or "bind" chlorine to an extent that CYA **significantly decreases** chlorine's ability to inactivate *Cryptosporidium* (Crypto).

CYA has long been used in pools and spas as a chlorine stabilizer (often times referred to as a "conditioner") to restrict the loss of free chlorine due to the sun's ultraviolet rays, and thereby sav-

Cryptosporidium is a protozoan parasite with a tough outer shell that can cause diarrhea and serious illness and can be fatal to those with weakened immune systems.



*Following a suspected *Cryptosporidium* outbreak in 2000, this splash pad in Sarasota, Florida removed this venue's trichlor system and installed a calcium hypochlorite system.*

Ensuring Bather Safety

The CDC's newly published data outlining CYA's impact on chlorination disinfection efficacy for destroying Crypto is significantly important to all concerned about bather safety.

Crypto caused a majority of waterborne gastrointestinal disease outbreaks in recreational swimming pools, spas and other water venues in the United States (see **Figure 1**).

It is transmitted by swallowing water from contaminated pools, waterparks, water rides, spas/hot tubs and other water venues and interactive fountains.

Research has shown that Crypto can live up to 10 days in a Model Aquatic Health Code (MAHC) compliant public or commercial pool, spa or other water venue with 1 ppm free chlorine. Yet the highest risk aquatic venues for

Crypto outbreaks are kiddie pools, therapy pools and interactive water features (IWFs) because the people that use these venues may be more susceptible to infection. Diaper aged children have a particularly high risk because they are both more likely to contaminate the water with feces and they are more likely to suffer from more severe illness when they become infected.



The MAHC has stricter regulations on these high-risk venues, which are often side features of larger aquatic venues. These "side features" typically use trichlor systems, because of the low cost feeder and ease of use for operators, thereby allowing them to focus primarily on their site's main attraction.

New CDC Study Findings Regarding Cyanuric Acid Use

The CDC regularly conducts scientific investigations to help local and state authorities make swimming and other recreational water activities healthier and safer. Although the current MAHC advises maintaining CYA levels at or below 100 mg/L, many commercial or public pools may exceed this level and may not be aware of the adverse impact on the efficacy of Crypto hypochlorite inactivation.

The CDC recently carried out a comprehensive study to better understand the impact of increasing CYA concentrations on Crypto inactivation (3-log_{10} CT values) and to revise current hyperchlorination recommendations based on the study's findings. The CDC findings were published in April, 2015.

Data from the study show that the "addition of CYA substantially delays Cryptosporidium inactivation as CYA concentration increases."

The study found that as little as 16 mg/L (16 ppm) of CYA can nearly triple the time (27.5 hours) needed to inactivate (3-log_{10} CT values) Crypto in the presence of 20 mg/L free chlorine, compared to no CYA present (8.2 hours).

At 50 mg/L CYA in water with 40 mg/L free chlorine present, the time needed to deactivate Crypto increased by up to 4.6 times compared to water with 40 mg/L free chlorine and no CYA present. Although the required 99.9% (3-Log_{10} CT values) inactivation level by hyperchlorination is extremely difficult to achieve under this condition (50 mg/L CYA), the data shows that Crypto inactivation at 100 mg/L CYA in water with 40 mg/L free chlorine **was not attainable in under 72 hours**.

According to the CDC study:

"In the presence of ~100 mg/L CYA, 1-log_{10} CT values could not be calculated due to the nonlinearity of the data; however, at 72 hours, average 0.8 and 1.4-log_{10} reductions were achieved with 20 and 40 mg/L free chlorine concentrations, respectively."

The data also indicates that "natural oocyst die-off" (translation: old age) played a substantial role in the

"On the basis of the results from this study, existing responses to diarrheal fecal incidents and suspected or confirmed recreational water-associated outbreaks of Cryptosporidiosis that rely on hyperchlorination are inadequate when used in pools that contain higher levels of cyanuric (50-100 mg/L), including concentrations currently acceptable in many state pool codes and the Model Aquatic Health Code."

Jennifer L. Murphy, et al., Waterborne Disease Prevention Branch, Centers for Disease Control and Prevention
"Effect of Cyanuric Acid on the Inactivation of *Cryptosporidium parvum* under Hyperchlorination Conditions"
Published: Environmental Science & Technology, April 2015

Outbreaks of Acute Gastrointestinal Illness associated with Treated Recreational Water, United States, 2003 - 2012

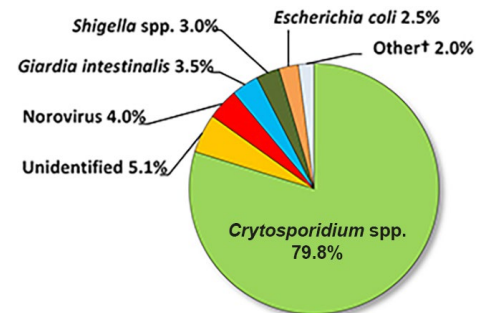


Figure 1. ¹

reduction of infectious oocyst over the extended experimental periods—with natural die-off of 0.5-log_{10} by 96 hours, and increasing to $\pm 2.4\text{-log}_{10}$ by 360 hours. In other words, when CYA was 100 ppm many of the oocysts died of old age rather than being killed by the "stabilized" chlorine.

Why Use More than ~8 ppm CYA?

The CDC data indicate that the addition of CYA substantially delays Crypto inactivation as CYA concentration increases, but hyperchlorination can still be effective in achieving 3-log_{10} removal when CYA levels in the water are low (~8 mg/L) as long as higher concentrations of free available chlorine (FAC) are used (~40 mg/L). See **Figure 2**.

This ratio of CYA to FAC during remediation procedures in the event of a diarrheal fecal release could provide a **practical solution for maintaining bather safety** while also retaining the UV stabilizing benefits (and chlorine cost savings) of CYA.

Rethinking Chlorination Strategy

*By maintaining a ~8 ppm CYA level in an outdoor commercial or public pool or spa by using CYA granules as needed, you can retain most of CYA's stabilizing benefit (84% per **Figure 2**.) and maintain a high enough oxidation reduction potential to satisfy local health codes (775 mV per **Figure 3**) and be able to remediate a fecal release in only 6.2 hours with a 40 ppm shock (see **Table 1**).*

Commercial or public pool owners and operators should **rethink their water chlorination strategy** because each time trichlor is added to a pool or spa, cyanuric acid is simultaneously added, with concentrations continuously rising since CYA remains in the water. CYA stabilized chlorine products may not provide sufficient control of CYA concentrations in the water.

Unlike chlorine, CYA is not consumed by the normal chemical treatment process for a swimming pool. CYA accumulates rapidly in the water and even in the filter media. This may be the reason why many operators of commercial or public pools find that after completely draining and refilling their pools, water analysis can still show CYA present.

How Quickly Can CYA Build Up In Your Pool If You Are Using Trichlor?

It's Basic Math

Trichlor is 55% CYA. A typical, moderately busy, 50,000 gallon commercial or public pool in the summer season will use 5 lbs. of available chlorine (5.55 lbs. of trichlor) every day. While the chlorine is consumed in the pool the CYA remains and will build up at the rate of 7.33 ppm per day! (see [Table 2.](#))

Is Dilution The Solution?

To date, the usual way commercial or public pool, spa or IWF recreational water operators remove CYA has been diluting with fresh water. However, with record droughts in many parts of the world, and water rates on the rise, this method is becoming less and less practical.

Again it's the math. In order to maintain the current MAHC maximum of 100 ppm CYA, the typical moderately used 50,000 gallon commercial or public pool will need to dump 3,500 gallons of pool water per day! This is about the same as refilling the pool with fresh water every two weeks!

Consider This!

In order to maximize the benefits of CYA while maintaining 8 ppm of CYA to allow for crypto remediation, a pool using trichlor would have to replace the entire volume of pool water daily!

Commercial water venue owners, municipalities and operators should consider alternative methods for chlorination such as the **CCH**® feeder systems, and they should use granular CYA only as needed to stabilize at 8 ppm.

Figure 2. At ~8 ppm CYA is 84% effective in retaining chlorine residual²

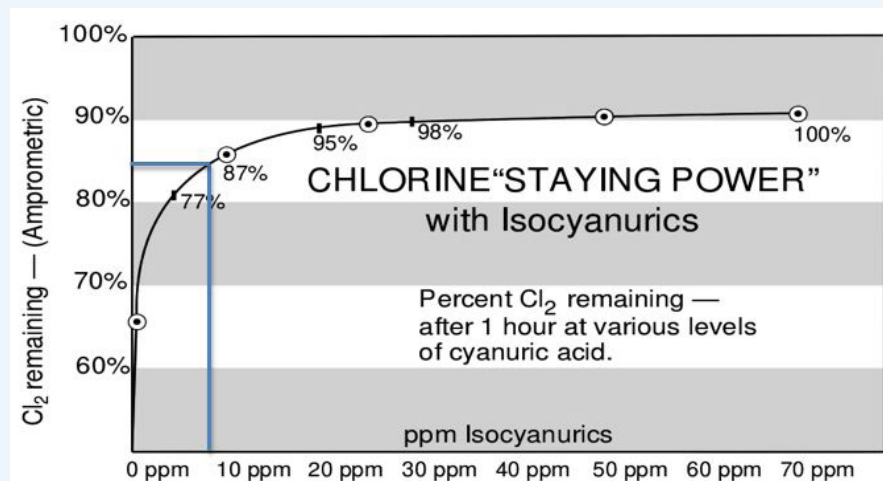


Figure 3. At ~8 ppm CYA and 1.5 Free Available = 770mV; Chlorine Produces 774 mV ORP³

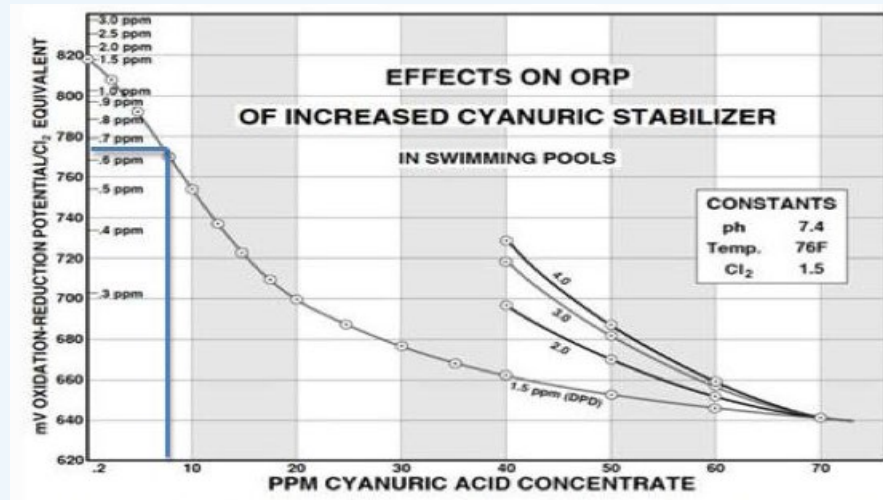


Table 1. At ~8 ppm CYA, Crypto Can Be Killed With 20 PPM FAC In 14 Hrs⁴

Average Estimated 3-log₁₀ Inactivation CT Values for *C. parvum* in Free Chlorine (FC) Controls and Low Concentration Cyanuric Acid (CYA) Experiments; Average pH 7.6

average FC conc. (mg/L)	average CYA conc. (mg/L)	average time 3-log ₁₀ inactivation (hr)	average estimated 3-log ₁₀ CT value (mg-min/L) (range)
21.6	0	8.2	10 500 (9 200 - 12 000)
21.1	8	14.1	17 800 (16 000 - 20 300)
19.1	16	27.5	31 500 (30 900 - 32 100)
40.6	0	5.1	12 400 (10 300 - 15 200)
40.9	9	6.2	15 300 (14 500 - 16 100)
38	15.00	8.4	19 400 (19 300 - 19 500)

Table 2.⁵

Pool size	AvCl use lbs per day	Trichlor used in lbs per day	CYA added to the pool in lbs per day	CYA residual added to the pool ppm per day
25,000	2.50	2.78	1.53	7.33
50,000	5.00	5.56	3.06	7.33
75,000	7.50	8.33	4.58	7.33
100,000	10.00	11.11	6.11	7.33



The Case For Using CCH® Calcium Hypochlorite

CCH® tablets have a high available chlorine with **no CYA stabilizer** providing balanced water and hardness in your pool water, which is especially beneficial for commercial or public pools that have plaster surfaces. Calcium hypochlorite chlorinates, removes organics and aids in the removal of metals, boosts hardness and shock treats in one simple process. CCH® tablets are a special blend of 68% available chlorine calcium hypochlorite that contain an additive that helps to reduce the carbonate scale associated with the alkalinity component of water. CCH® feeder systems allow a facility to make hypochlorite solution only as needed, eliminating the need for bulk solution or gas cylinder storage.

Optimizing Water Balance

Arch Chemicals, Inc., a Lonza Company, has decades of experience developing and improving processes of water sanitation using dry calcium hypochlorite. Over the years, this effort has brought the delivery of more predictable chlorine levels and a further optimization of water balance to commercial and public water venues.

The benefits of the CCH® system are:

- Chlorinates, removes organics, aids metal removal, boosts hardness and shock treats, in one simple process
- Contains no cyanuric acid
- No liquid transfer spills

- Reduces chloramine odors
- Simplifies maintaining pH balance
- Promotes longer pool and equipment life, compared to bleach
- Less acid consumption than liquid bleach
- Smaller footprint than most liquid bleach systems
- Does not lose solution strength over time
- Chlorinating solution is made only when needed
- Improves water clarity, color and sparkle

Maintaining proper water chemistry is of paramount importance. Owners, operators and patrons of commercial or public pools, waterparks and spas deserve a complete sanitizing solution that they can be confident in. Arch Chemicals, Inc., a Lonza Company, is one of the premier resources for expert answers, outstanding support, and reliable, easy-to-use pool water chlorination.



CCH® tablets and patented erosion technology work in tandem to efficiently manage water chlorination.

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TABLET SPECIFICATIONS

Active Ingredient. Calcium Hypochlorite
Available Chlorine. 65%
Weight. 300 gms
Diameter. 2–5/8"
Color. Pale Blue
Container. 50lb pails

FEEDER SPECIFICATIONS

DIMENSIONS

Feeder dimensions (max). Width: 16" (40.7 cm)
Depth: 19" (48.3 cm)
Height: 29" (73.7 cm)
Weight (empty). 18 lbs (8.17 kg)
Tubing size (O.D.). 1/2" (12.7 mm)

CAPACITY AND FEED RATE

Capacity (weight of tablets). 13 lbs (5.91 kg)
Feed-rate range (AvCl/day). ~0.5 lbs (0.23 kg) - min
~18 lbs (8.18 kg) - maximum

NSF® 50 CERTIFIED

The National Sanitation Foundation audits each manufacturing facility to ensure that the CCH® Autofeed system meets the requirements of NSF®/ANSI Standard 50 – a program including product testing, certification and manufacturing facility audits. Compliance with Standard 50 is necessary to ensure safe pool and spa water.

References and Acknowledgements

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- ⁵Dave Blanchette, 2015, Lonza Microbial Control.

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