



Comparing Operating Costs of Sanitizers: Calcium Hypochlorite and Trichlor

The choice of sanitizer can cost a large aquatic facility a lot of money. This paper will discuss potential costs associated with two common sanitizers, calcium hypochlorite (cal hypo) and trichloroisocyanuric acid (trichlor).

When these sanitizers are added to pool water, along with increasing the available chlorine, they will affect pH, alkalinity and either calcium hardness or cyanuric acid. One way to think about it is that every time these sanitizers are added to the water, additional chemicals “inside” the sanitizer are added as well. Sometimes these “extra” chemicals are beneficial, and sometimes you will have to pay to get rid of them.

An estimate of 2017 Fulton County water and sewage costs combined with 2017 chemical costs shows that costs incurred by facility’s using calcium hypochlorite might be considerably less than the aggregate costs for the same facility using trichlor. The chart below shows estimated costs when adding 10 ppm available chlorine (AvCl₂) to a pool using the two sanitizers, and an explanation of the assumptions used for the estimate follows.

Size of Pool (gal)	Daily Costs		30-Day Costs	
	Cal Hypo	Trichlor	Cal Hypo	Trichlor
10,000	\$ 4.51	\$ 12.85	\$ 135.30	\$ 383.59
25,000	\$ 11.28	\$ 32.13	\$ 338.25	\$ 963.96
50,000	\$ 22.55	\$ 64.26	\$ 676.51	\$ 1,927.93
75,000	\$ 33.83	\$ 96.40	\$ 1,014.76	\$ 2,891.89
100,000	\$ 45.10	\$ 128.53	\$ 1,353.01	\$ 3,855.35

* Assumptions for these estimates are discussed below.
 ** Each pool environment is different and actual costs may fluctuate.

Explanation of Assumptions and Estimates

When estimating the costs of sanitizing pool water, simply looking at the cost per pound of sanitizer does not take into account less obvious costs and may lead to false

assumptions about savings. When added to pool water, cal hypo increases the available chlorine, pH, alkalinity and calcium hardness (“CH”). Trichlor, when added, increases available chlorine and cyanuric acid (“CYA”), but decreases pH and alkalinity. As a result of the choice of sanitizer, a facility may need to replace some of its pool water to counter the increasing CH or CYA level. Accordingly, the facility’s choice of sanitizer can result in increased water and sewage costs. Further, both sanitizers affect pH and alkalinity, this will typically need to be corrected with additional chemicals, further increasing costs.

Every pool environment is different and accounting for every scenario may be impossible. In order to estimate costs incurred by the use of these sanitizers, certain assumptions have been made for this comparison. The following explanations describe the reasoning behind these assumptions.

Water Usage

Water usage is a big component of running any aquatic facility. As mentioned, cal hypo adds calcium hardness and trichlor adds cyanuric acid. Neither CH or CYA are destroyed by chlorine, nor do they evaporate. Draining and replacing the water is the only practical way to decrease concentrations. Splash out and back washing the filter will reduce these concentrations, however estimating water consumption rates of these activities is difficult and can change from pool to pool, so water usage from these activates were left out of this paper’s estimates. Since evaporation does not remove either chemical, water consumption from evaporation was not factored directly into costs.

Cal Hypo:

- Calcium hardness (CH) plays a vital role in water chemistry, helping to protect plaster, concrete and metal objects from corrosion caused by aggressive water. A minimum of 150 ppm CH is required for pool water (ANSI/APSP-11 15), with 200 ppm CH recommended

for plaster pools (NPC). Between 150 - 1000 ppm CH, the saturation index can be maintained to prevent scale and cloudy water formation (ANSI/APSP-11 15).

- Adding 10 ppm AvCl₂ using calcium hypochlorite will add 8 ppm CH (APSP Calcium). For a pool starting at 150 ppm CH, adding 10 ppm AvCl₂ daily with calcium hypochlorite would cause the CH in the pool water to reach 1006 ppm in 107 days. When the water reaches 1000 ppm CH, removing and replacing 1 % will drop the CH 8 ppm if the source water is 200 ppm CH. This will counter the CH added by the daily dose of calcium hypochlorite at these concentrations and rates. In 100,000 gallon pool this is equal to 1000 gallons.

Trichlor:

- Cyanuric acid (CYA) helps protect the available chlorine from decomposition caused by UV light. A maximum of 100 ppm CYA is recommended by ANSI/APSP-11 2009, and a maximum 90 ppm CYA by the Model Aquatic Health Code (MAHC 211). CYA is unnecessary and not recommended for indoor pools (ANSI/APSP-11 22).
- Adding 10 ppm AvCl₂ using trichlor will add 6 ppm CYA (APSP Trichlor). For a pool starting at 30 ppm, adding 10 ppm AvCl₂ daily with trichlor would cause the CYA in the pool water to reach 90 ppm in 10 days and 102 ppm in 12 days. At 90 ppm CYA, 6.7% of the water must be removed and replaced to counter this daily addition of trichlor. At 100 ppm CYA, removing and replacing 6.0% of the water will counter the CYA added daily by the use of trichlor. For a 100,000 gallon pool that is 6,700 gallons and 6,000 gallons respectively.

Estimating Water and Sewage Costs

Water and sewage costs are a big opportunity for pool operators to save money. The examples above show that to provide the same amount of available chlorine, it can take 6 times or more water to keep the CYA in a recommended range when using trichlor than the amount of water that is needed to keep the CH in a recommended range when using calcium hypochlorite. Since this water must be drained and refilled, it stands to reason that in locations where sewer costs are based on consumption, not only would the water costs be 6 times higher, but sewer costs would be as well.

Water and sewage costs are quite different around the country; calculating them can be complex. Water and sewage prices change from location to location. In this analysis, we used Fulton County Georgia's 2017 water and sewage costs. Prices scale up depending on monthly usage (Water & Sewer Rates). To compare apples to apples, we assumed that the source water contains 200 ppm CH, the maximum recommendations of CH or CYA had been reached (so draining and refilling is necessary), and the top tier water price had been reached by water consumption not associated to the sanitizer (water cost \$0.0100 per gallon and sewage cost \$0.0055 per gallon). Water loss due to evaporation, splash out and filter backwashing was excluded. The below table estimates the daily and monthly (30 day) water and sewer costs that would be charged by Fulton County, Georgia for the amount of water replacement needed to maintain recommended CH or CYA levels for a pool if adding 10 ppm AvCl₂ daily:

Size of Pool (gal)	Daily Water Usage (gal)		Daily Water Cost		Daily Sewer Cost		Monthly Water and Sewer Costs	
	Cal Hypo	Trichlor	Cal Hypo	Trichlor	Cal Hypo	Trichlor	Cal Hypo	Trichlor
10,000	100	600	\$ 1.00	\$ 6.00	\$ 0.55	\$ 3.30	\$ 46.50	\$ 279.00
25,000	250	1,500	\$ 2.50	\$ 15.00	\$ 1.38	\$ 8.25	\$ 116.25	\$ 679.50
50,000	500	3,000	\$ 5.00	\$ 30.00	\$ 2.75	\$ 16.50	\$ 232.50	\$ 1,395.00
75,000	750	4,500	\$ 7.50	\$ 45.00	\$ 4.13	\$ 24.75	\$ 349.75	\$ 2,093.50
100,000	1,000	6,000	\$ 10.00	\$ 60.00	\$ 5.50	\$ 33.00	\$ 465.00	\$ 2,790.00

Although it is not included in these calculations, there will also be increased cost for adjusting the water balance of the fill water.

Chemical costs

In addition to changing the CH or CYA levels, these sanitizers affect the pH and alkalinity of the pool water. Calcium hypochlorite contains small amounts of calcium hydroxide and calcium carbonate, which results in slightly increased pH and total alkalinity. In theory, 10.5 ounces of calcium hypochlorite added to a 10,000 gal pool (i.e. 5.1 ppm AvCl₂) will increase the pH by 0.009 and carbonate alkalinity by 0.29 ppm (pH 7.5, 100 ppm carbonate alkalinity, 100 ppm CA, and 1000 ppm TDS) (Wojtowicz). Conversely, in the same pool, 7 oz. of trichlor (i.e. 4.7 ppm AvCl₂) will theoretically decrease the pH by 0.14 and decrease the total alkalinity by 3.3 ppm (Wojtowicz).

Muriatic acid and sodium carbonate are common choices for large commercial and municipal pools to neutralize pH changes in pool water. Although there are other methods to neutralize the pH changes, this paper assumes the use of muriatic acid to neutralize the increased pH caused by calcium hypochlorite, and sodium carbonate to neutralize the pH decrease caused by trichlor. A study performed by Olin Corporation found, on average, 1.56 oz. of 32% muriatic acid neutralized the pH of one pound of calcium hypochlorite (Oberson). In the same Olin study, 0.93 pounds of sodium carbonate was found to neutralize the pH of one pound of trichlor (Oberson).

Combined chemical costs were determined using the above chemical usage rates for pH neutralization and the following chemical costs:

- Calcium hypochlorite - \$2.30 per pound
- 32% muriatic acid - \$0.055 per ounce (\$7.00 per gal)
- Trichlor - \$2.16 per pound
- Sodium carbonate - \$1.80 per pound

The chemical cost to counter the pH effect of 1 lb. of cal hypo adds \$0.09, where the chemical costs to counter the pH effect of 1 lb. of trichlor adds \$1.67 per pound. The combined chemical costs per pound of cal hypo would be \$2.39, and per pound of trichlor would be \$3.83. With cal hypo at 68% AvCl₂, and trichlor at 90% AvCl₂, the combined chemical costs per pound of AvCl₂ for cal hypo would be \$3.51 and trichlor would be \$4.26. With 10 ppm AvCl₂ is provided daily, the chart below estimates the daily and monthly costs for several pool sizes:

Size of Pool (gal)	Cal Hypo (lbs.)	HCL (oz.)	Trichlor	Sodium Carbonate (lbs.)	Daily Chemical Cost		Monthly Chemical Costs	
					Cal Hypo	Trichlor	Cal Hypo	Trichlor
10,000	1.24	1.93	0.93	0.86	\$ 2.96	\$ 3.55	\$ 88.80	\$ 106.59
25,000	3.10	4.83	2.32	2.15	\$ 7.40	\$ 8.88	\$ 222.00	\$ 266.46
50,000	6.21	9.65	4.63	4.31	\$ 14.80	\$ 17.76	\$ 444.01	\$ 532.93
75,000	9.31	14.48	6.95	6.46	\$ 22.21	\$ 35.53	\$ 666.01	\$ 799.39
100,000	12.41	19.30	9.27	8.62	\$ 29.60	\$ 35.53	\$ 888.01	\$1,065.85

Estimated Water, Sewer and Chemical Costs

The chart below combines the daily chemical the water and sewer costs that would be charged by Fulton County, Georgia:

Size of Pool (gal)	Chemical Costs		Water Costs		Sewage Costs		Total Daily Costs	
	Cal Hypo	Trichlor	Cal Hypo	Trichlor	Cal Hypo	Trichlor	Cal Hypo	Trichlor
10,000	\$ 2.96	\$ 3.55	\$ 1.00	\$ 6.00	\$ 0.55	\$ 3.30	\$ 4.51	\$ 12.85
25,000	\$ 7.40	\$ 8.88	\$ 2.50	\$ 15.00	\$ 1.38	\$ 8.25	\$ 11.28	\$ 32.13
50,000	\$ 14.80	\$ 17.76	\$ 5.00	\$ 30.00	\$ 2.75	\$ 16.50	\$ 22.55	\$ 64.26
75,000	\$ 22.20	\$ 26.65	\$ 7.50	\$ 45.00	\$ 4.13	\$ 24.75	\$ 33.83	\$ 96.40
100,000	\$ 29.60	\$ 35.53	\$ 10.00	\$ 60.00	\$ 5.50	\$ 33.00	\$ 45.10	\$ 128.53

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