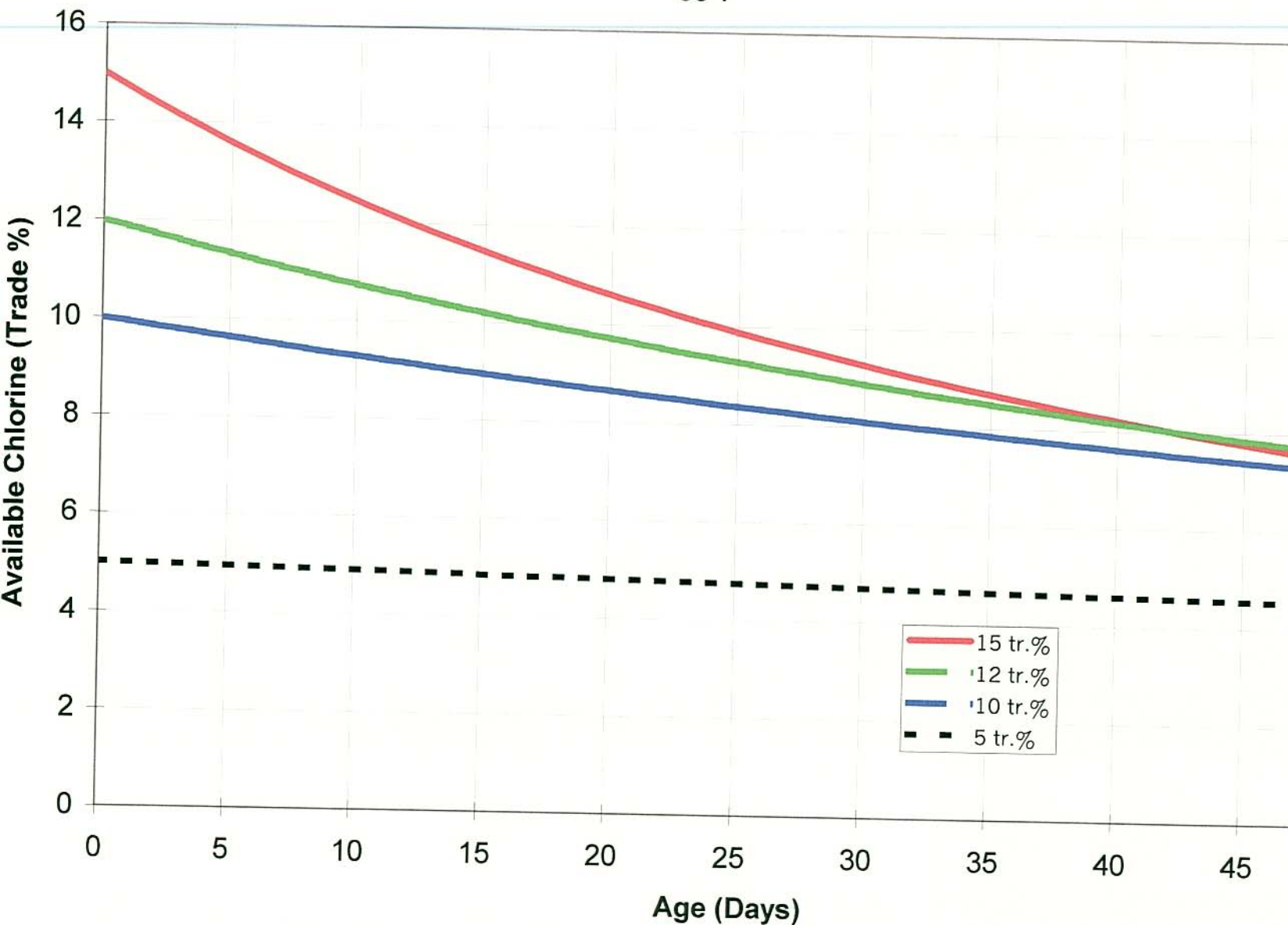


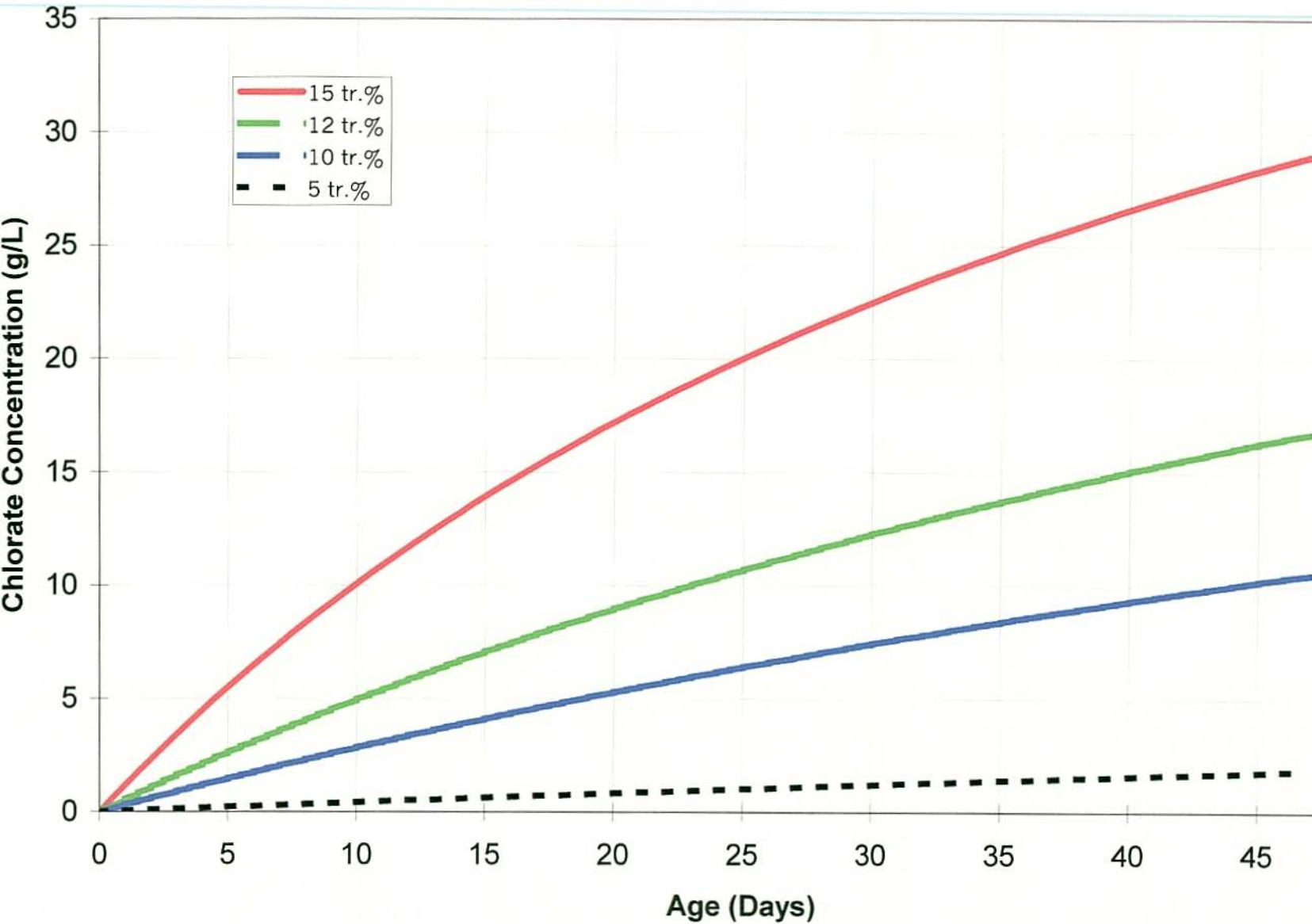
Bleach Decomposition

85°F



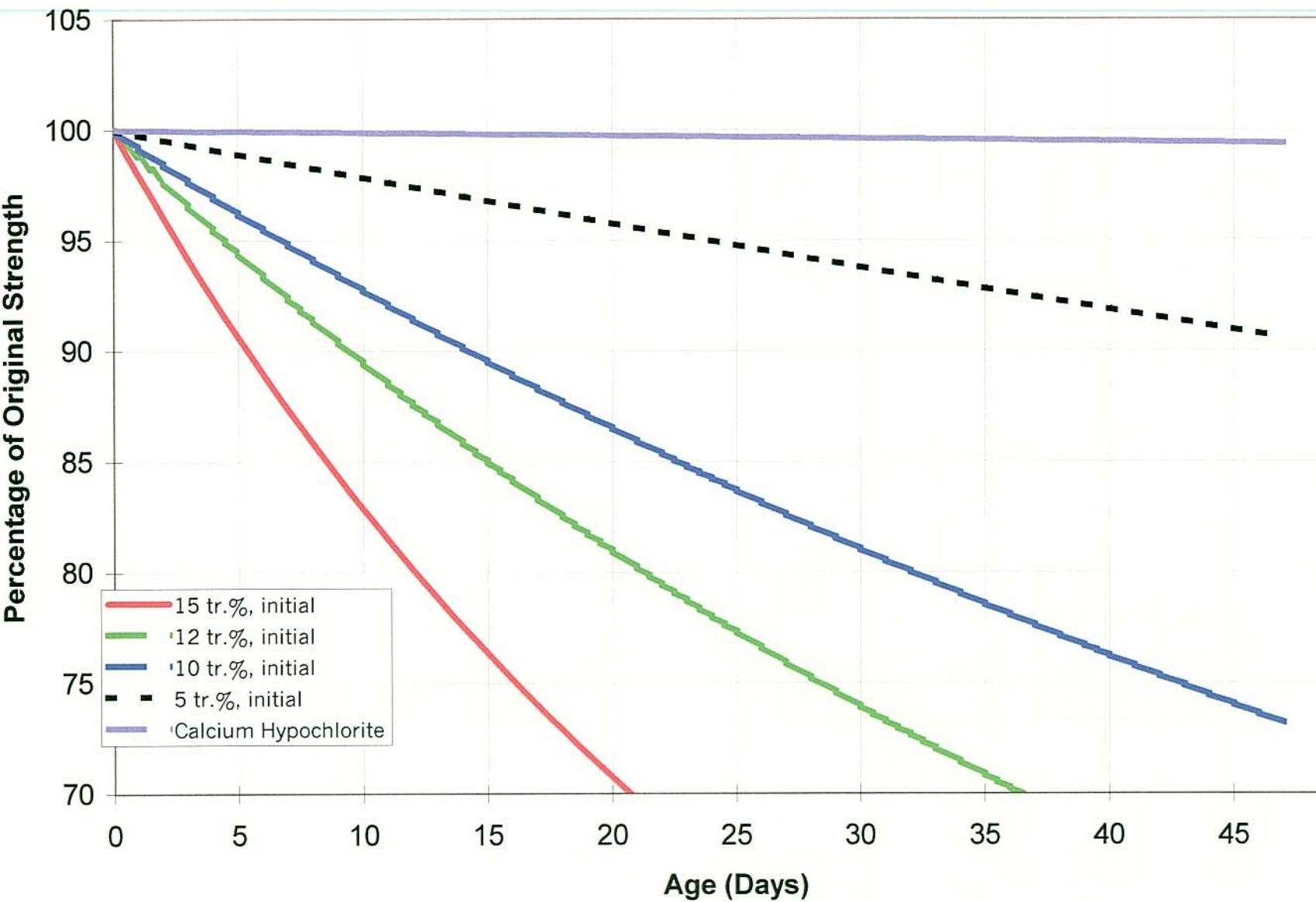
Bleach Decomposition

85°F



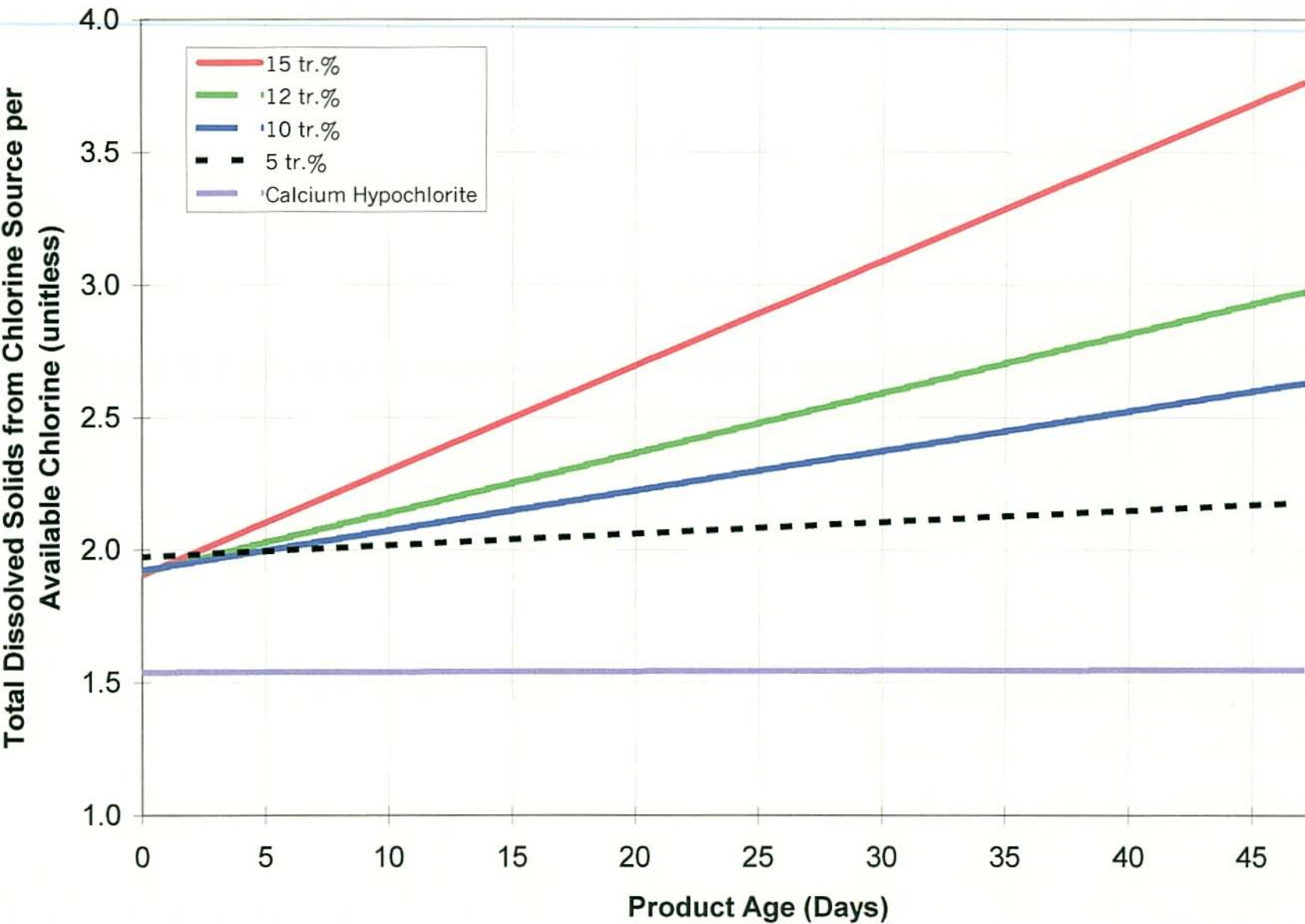
Bleach Decomposition

85°F



TDS/Av. Cl. in Product

85°F



Sodium Hypochlorite

NaOCl

Liquid chlorine or bleach production



Bleach into pool water



- Strength 10%-15%
- pH 13—Large acid demand

Inconvenient:

- Frequent purchases required
- Sloppy to apply
- Corrosive to truck & equipment
- Dangerous to transport bleach & acid together
- Will bleach clothing
- Quality varies
- Can result in salty taste to water

Unstable:

- In storage—in transit
- Effects of high temperature
- In use—lost to UV

Chemical Comparison For 120,000 US Gal. Pool

Type	Percent of Sanitizer	Oxidation Potential Volts	pH Effect	Capital Cost	Operating Cost	Maintenance Requirement	Environmental & Safety Impact	Physical Appearance	Potential To Form Vocs	Recommended Support Chemicals
Gas Chlorine	100	1.49	Lowers pH <1.0	\$10,000 to \$12,000	\$1,700	Heavy due to low pH	Extremely toxic. Requires extensive safety equipment.	Gas	High. Due to inability to oxidize organic compounds.	Soda Ash - pH adjustment. Sodium Bi-carbonate - alkalinity adjustment. Non-Halogenated shock - Reduction of combined chlorine.
Sodium Hypochlorite	13 to 15	1.49	Raises pH 13.0	\$800 to \$1,000	\$5,475	Moderate if mixing water exceeds 4 grains of hardness.	Alkaline solution can be harsh to handle. Forms toxic gas if mixed with acid.	Liquid	High: Due to inability to oxidize organic compounds.	Muriatic Acid - pH adjustment. Carbon Dioxide - pH adjustment. Sodium Bi-Carbonate-Alkalinity adjustment. Non-Halogenated shock - Reduction of combined chlorine.
Calcium Hypochlorite	65 to 70	1.49	Raises pH 11.8	\$800 to \$1,000	\$3,650	Heavy due to high calcium content readily forming scale.	Alkaline solution can be harsh to handle. Forms toxic gas if mixed with acid. Can be explosive if improperly mixed with water.	Granular Tablets	High. Due to inability to oxidize organic compounds.	Same as above.
Bromine & Ozone	65 to 70 & 100	.78 & 2.07	Neutral. Slight effect on pH, secondary reaction through free radical formation will affect alkalinity.	\$28,000 to \$30,000	\$4,800	Ozone requires semi-annual maintenance by qualified service technician. Bromine is moderate due to application of erosion feeder concept.	Bromine must be stored dry. Can be harsh, if wet. Ozone and Bromine don't readily form VOCs when injected into water. Ozone is 4 times less toxic than gas chlorine. Bromine ion is reclaimed through use of ozone and reduces sanitizer demand to 60-80%.	Granular Tablets & Gas	Low. Has ability to oxidize organics to bio-degradable state.	Carbon Dioxide - pH adjustment. Sodium Bi-Carbonate - Alkalinity adjustment.
Ozone (must be accompanied with another sanitizer)	100	2.07	Neutral. No direct effect, secondary reaction through free radical formation will affect alkalinity.	\$55,000 to \$65,000	\$5,400	Required semi-annual maintenance by qualified service technician.	Doesn't readily form VOCs when injected into water. 4 times less toxic than gas chlorine.	Gas	Low. Has ability to oxidize organics to bio-degradable state.	Sodium Hypochlorite - Sanitization. Carbon Dioxide - pH adjustment. Sodium Bi-Carbonate - Alkalinity adjustment.

Note: chloramines, chlorinated by-products are all readily volatile in nature. this results in a high degree of potential to form irritable aromatic compounds in the building envelope and aggravating water quality. CO₂ should only be used in facilities with a make-up water alkalinity below 110ppm or on systems with a properly engineered ozone system. CO₂ doesn't form an acid until injected into water and is not toxic in the gas phase.

TDS/Av. Cl. in Product

85°F

