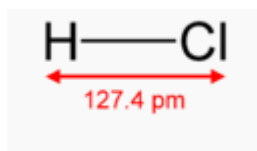


# Wikipedia Chemistry

## TO LOWER pH and LOWER TOTAL ALKALINITY

### MURIATIC ACID – HCl

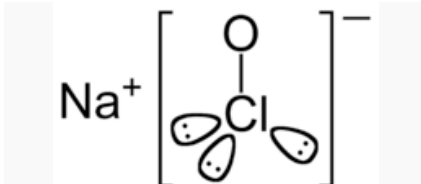


**Hydrochloric acid** is a clear, colorless, highly [pungent solution](#) of [hydrogen chloride \(HCl\)](#) in water. It is a highly [corrosive, strong mineral acid](#) with many industrial uses. Hydrochloric acid is found naturally in [gastric acid](#). When it reacts with an organic base it forms a [hydrochloride](#) salt.

It was historically called **acidum salis**, **muriatic acid**, and **spirits of salt** because it was produced from [rock salt](#) and [green vitriol](#) (by [Basilius Valentinus](#) in the 15th century) and later from the chemically similar [common salt](#) and [sulfuric acid](#) (by [Johann Rudolph Glauber](#) in the 17th century). Free hydrochloric acid was first formally described in the 16th century by [Libavius](#). Later, it was used by chemists such as [Glauber](#), [Priestley](#), and [Davy](#) in their scientific research.

## DISINFECTION

### SODIUM HYPOCHLORITE – BLEACH – “LIQUID CHLORINE” – NaClO



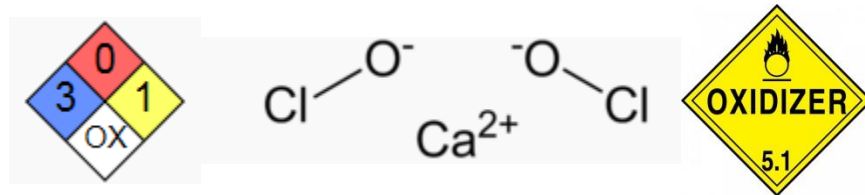
**Sodium hypochlorite** is a [chemical compound](#) with the [formula](#) NaClO. It is composed of a [sodium cation](#) ( $\text{Na}^+$ ) and a [hypochlorite anion](#) ( $\text{ClO}^-$ ); it may also be viewed as the sodium [salt](#) of [hypochlorous acid](#). When dissolved in water it is commonly known as **bleach**, or **liquid bleach**. Sodium hypochlorite is practically and chemically distinct from [chlorine](#). Sodium hypochlorite is frequently used as a [disinfectant](#) or a [bleaching agent](#).

Household [bleach](#) is, in general, a solution containing 3–8% sodium hypochlorite and 0.01–0.05% [sodium hydroxide](#); the sodium hydroxide is used to slow the decomposition of sodium hypochlorite into [sodium chloride](#) and [sodium chlorate](#).

US Government regulations allow food processing equipment and food contact surfaces to be sanitized with solutions containing bleach, provided that the solution is allowed to drain adequately before contact with food, and that the solutions do not exceed 200 parts per million (ppm) available chlorine (for example, one tablespoon of typical household bleach containing 5.25% sodium hypochlorite, per gallon of water). If higher concentrations are used, the surface must be rinsed with potable water after sanitizing.

# DISINFECTION

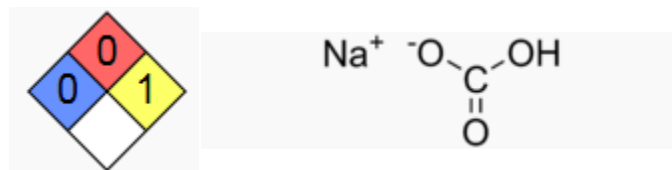
## CALCIUM HYPOCHLORITE – “DRY, POWERED CHLORINE” – $\text{Ca}(\text{ClO})_2$



**Calcium hypochlorite** is an [inorganic compound](#) with [formula](#)  $\text{Ca}(\text{ClO})_2$ . As a mixture with lime and calcium chloride, it is marketed as **chlorine powder** or **bleach powder** for [water treatment](#) and as a [bleaching](#) agent. This compound is relatively stable and has greater available [chlorine](#) than [sodium hypochlorite](#) (liquid bleach). It is a white solid, although commercial samples appear yellow. It strongly smells of [chlorine](#), owing to its slow decomposition in moist air. It is not highly soluble in water and is more preferably used in [soft to medium-hard water](#). It has two forms: dry and hydrated. Calcium hypochlorite is commonly used to [sanitize public swimming pools](#) and [disinfect drinking water](#). Generally the commercial substance is sold with a purity of a 68% (with other additives and contaminants varying based upon the product's intended purpose). For instance as a swimming pool chemical it is often mixed with [cyanuric acid](#) stabilizers and [anti-scaling agents](#) (in order to reduce the loss of chlorine from [ultraviolet](#) radiation and to prevent [calcium hardening](#)). Calcium hypochlorite is also used in kitchens to [disinfect](#) surfaces and equipment. Other common uses include [bathroom](#) cleansers, household disinfectant sprays, [algaeicides](#), [herbicides](#), and laundry [detergents](#).

# TO RAISE TOTAL ALKALINITY

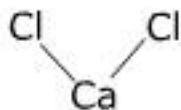
## SODIUM BICARBONATE – BAKING SODA – $\text{NaHCO}_3$



**Sodium bicarbonate** ([IUPAC name](#): **sodium hydrogen carbonate**) is a [chemical compound](#) with the formula  $\text{NaHCO}_3$ . It is a [salt](#) composed of [sodium](#) ions and [bicarbonate](#) ions. Sodium bicarbonate is a white solid that is [crystalline](#) but often appears as a fine powder. It has a slightly salty, [alkaline](#) taste resembling that of washing soda ([sodium carbonate](#)). The natural mineral form is [nahcolite](#). It is a component of the mineral [natron](#) and is found dissolved in many [mineral springs](#). It is among the [food additives](#) encoded by [European Union](#), identified as [E 500](#). Since it has long been known and is widely used, the salt has many related names such as **baking soda**, **bread soda**, **cooking soda**, and **bicarbonate of soda**. The word *saleratus*, from [Latin](#) *sal aërat* meaning "aerated salt", was widely used in the 19th century for both sodium bicarbonate and [potassium bicarbonate](#).

## TO RAISE CALCIUM HARDNESS

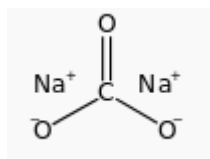
### CALCIUM CHLORIDE – $\text{CaCl}_2$



**Calcium chloride** ([chemical formula](#)  $\text{CaCl}_2$ ) is the [ionic compound](#) of [calcium](#) and [chlorine](#). It is a [salt](#) that behaves as a typical ionic [halide](#), being [solid](#) at [room temperature](#) and highly [soluble](#) in water. Common applications include [brine](#) for refrigeration plants, [ice](#) and dust control on roads, and [desiccation](#). Because of its [hygroscopic](#) nature, attracting and holding water, [anhydrous](#) calcium chloride must be kept in airtight containers.

## TO RAISE pH

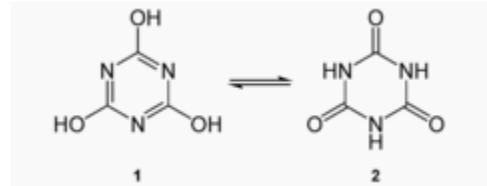
### SODIUM CARBONATE – SODA ASH – $\text{Na}_2\text{CO}_3$



**Sodium carbonate** (also known as **washing soda**, **soda ash** and **soda crystals**),  $\text{Na}_2\text{CO}_3$ , is the water-soluble [sodium salt](#) of [carbonic acid](#). It most commonly occurs as a [crystalline heptahydrate](#), which readily [effloresces](#) to form a white powder, the monohydrate. Pure sodium carbonate is a white, odorless powder that is [hygroscopic](#) (absorbs moisture from the air). It has a strongly alkaline taste, and forms a moderately basic solution in water. Sodium carbonate is well known domestically for its everyday use as a [water softener](#). It can be extracted from the ashes of many plants growing in sodium-rich soils, such as vegetation from the Middle East, kelp from Scotland and seaweed from Spain. Because the ashes of these sodium-rich plants were noticeably different from ashes of timber (used to create [potash](#)), they became known as "soda ash". It is synthetically produced in large quantities from salt ([sodium chloride](#)) and [limestone](#) by a method known as the [Solvay process](#).

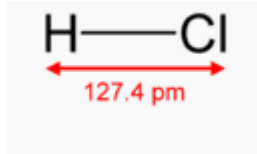
# TO PROTECT CHLORINE IN THE POOL FROM BEING DESTROYED BY THE SUN

## CYANURIC ACID – (CNOH)<sub>3</sub>



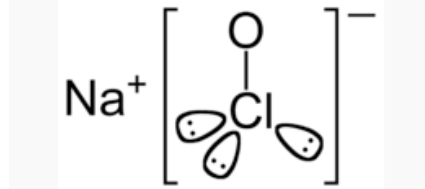
**Cyanuric acid** or **1,3,5-triazine-2,4,6-triol** is a [chemical compound](#) with the [formula](#) (CNOH)<sub>3</sub>. Like many industrially useful chemicals, this [triazine](#) has many synonyms. This white, odorless solid finds use as a precursor or a component of [bleaches](#), disinfectants, and herbicides. In 1997, worldwide production was 160 million kilograms.

TO LOWER pH & LOWER TOTAL ALKALINITY MURIATIC ACID – HCl



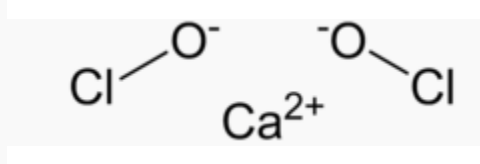
DISINFECTION

SODIUM HYPOCHLORITE – BLEACH – “LIQUID CHLORINE” – NaClO



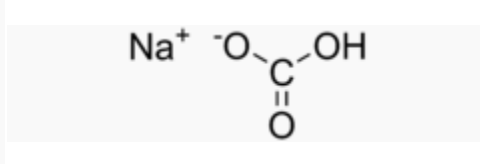
DISINFECTION

CALCIUM HYPOCHLORITE – “DRY, POWERED CHLORINE” – Ca(ClO)<sub>2</sub>



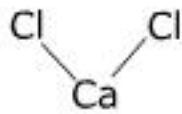
TO RAISE TOTAL ALKALINITY

SODIUM BICARBONATE – BAKING SODA – NaHCO<sub>3</sub>



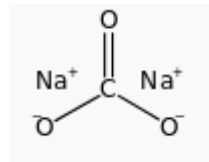
TO RAISE CALCIUM HARDNESS

CALCIUM CHLORIDE – CaCl<sub>2</sub>



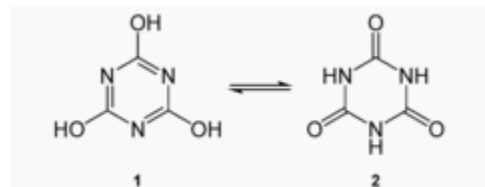
TO RAISE pH

SODIUM CARBONATE – SODA ASH – Na<sub>2</sub>CO<sub>3</sub>

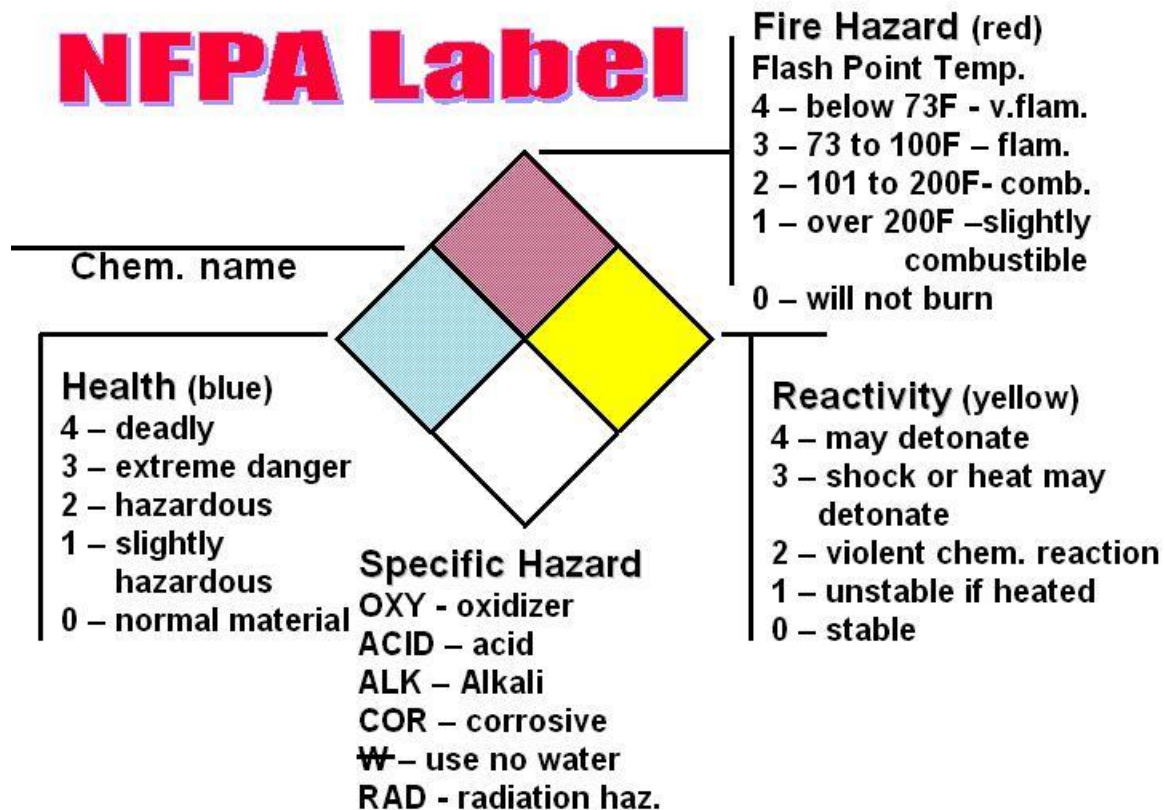


TO PROTECT CHLORINE IN THE POOL FROM BEING DESTROYED BY THE SUN

CYANURIC ACID – (CNOH)<sub>3</sub>



# NFPA Label



**National Fire Prevention Association (NFPA) labels are recognized by firefighters and other first-responders.**

## Frequently Asked Questions about NFPA 704

### Standard System for the Identification of the Hazards of Materials for Emergency Response






#### 1. What is NFPA 704?

**NFPA 704** provides a simple, readily recognized, easily understood system for identifying the specific hazards of a material and the severity of the hazard that would occur during an emergency response. The system addresses the health, flammability, instability, and special hazards presented from short-term, acute exposures that could occur as a result of a fire, spill, or similar emergency.

#### 4. Why should I use the NFPA 704 rating system?

NFPA 704 labels provide an appropriate signal or alert for the protection of emergency response personnel, assist in planning for effective fire and emergency control operations, including cleanup. It can also assist all designated personnel, engineers, plant, and safety personnel in taking inventory and evaluating the relative hazards of materials in their facility.

Ref: [http://www.nfpa.org/Assets/files/AboutTheCodes/704/704\\_FAQs.pdf](http://www.nfpa.org/Assets/files/AboutTheCodes/704/704_FAQs.pdf)

Diamond	Hazard	Value	Description
	 Health	3	Can cause serious or permanent injury.
	 Flammability	0	Will not burn under typical fire conditions.
	 Instability	1	Normally stable but can become unstable at elevated temperatures and pressures.
	 Special	OX	Possesses oxidizing properties.

## Before Handling Chemicals

***Read the Material Safety Data Sheets that are stored in the lifeguard office. Consult with me if you have any questions.***

Tips:

- The dry chlorine poses a breathing hazard. It's also very bad for your eyes. When you open its bucket don't put your face down near it.
- The liquid acid especially poses a breathing hazard from the vapors that rise up quickly from the open bottle. A vapor cloud can also occur when you pour it into the pool; it can drift across the entire deck and grass. Be mindful. Safeguard yourself and all the patrons.
- And whatever you do, don't mix the acid with chlorine! The resulting gas is deadly.

## **Record all chemical additions**

Every use of these chemicals should be recorded on a log in the office. There is a seasonal log sheet for each pool hanging on the small bulletin board.

Measure the amount used and accurately document it on the log for everyone to see.



## **Resist the urge to use large doses of these chemicals.**

Instead, add smaller amounts over time. Examples:

- Add no more than 5 pounds of cyanuric acid to the main pool per day. This should increase the concentration by about 5 ppm. So, add 5 pounds, record on the log sheet, wait a day or two and retest the water. Only then should you consider adding another 5 pounds.
- One blue cup of calcium hypochlorite will increase the main pool's concentration by about 1 ppm. While it might seem a convenient alternative to the liquid sodium hypochlorite, this powdered form will make the main pool cloudy. Therefore, use it sparingly and only as an emergency measure.
- For the wading pool use only itsy-bitsy baby-sized amounts of chemicals.

Factors that directly influence how these Aquasol controllers correlate **Oxidation Reduction Potential (ORP)** measurements to **Total Free Chlorine** include:

1) **Cyanuric acid level** – keep it steady at **50 ppm**.

A minimum of 30 ppm is often suggested for the cyanuric to protect the chlorine from sun damage, but we use a 50 ppm target so as to provide a margin of error. Please don't exceed 50 ppm as increased binding of the chlorine atom further reduces its effectiveness.

2) **pH** – again, keep it within range & steady. The proportion of different free chlorine species in solution (*hypochlorous acid vs hypochlorite ion*) is directly impacted by pH. Manually add appropriate amounts of muriatic acid to lower the pH as needed. But again, keep it steady.

3) **Sunlight & Temperature**

A minimum ORP of 650 millivolts will be targeted.

If you feel you need to dose the wading pool manually use **no more** than 1/2 cup (*4 ounces, 120 ml*) of sodium hypochlorite at a time. Let it circulate 15 minutes and test again.

Kevin Kendall will make all adjustments to these Aquasol controllers.

*Kevin Kendall 410-562-1437 6/2016*

**Free Available Chlorine** - the hypochlorous acid species  
*(free, uncombined, effective)*

**Total Free Chlorine** – the sum of hypochlorous acid &  
hypochlorite ion  
*(free, uncombined)*