

CHLORINATION OF WATER

Chlorine gas is commonly used in industrial/municipal water treatment. It is the cheapest source of chlorine; however, expensive injection equipment must be used. Chlorine is a problem gas: It is poisonous to human beings, and it can corrode and clog injection equipment.

Characteristics of Chlorine:

-Chlorine is a yellowish-green gas with an irritating and suffocating smell; it attacks the membranes of the throat, lungs, and nose causing serious injury even at low concentrations—**IT IS A VERY POISONOUS GAS.**

-Chlorine is easily liquified under pressure and is stored as a liquid in steel cylinders.

-Chlorine gas is soluble in water; the interaction produces hypochlorous acid (HOCl). Hypochlorous acid is a powerful oxidizing agent, and its germ killing action is either by oxidizing the microorganism or by preventing the cells from oxidizing glucose. The biocidal action of hypochlorous acid is greatest at pH's below 7.5.

-When warmed and/or exposed to sunlight, hypochlorous acid decomposes to oxygen and hydrochloric acid, and the germicidal effect is diminished.

Sodium hypochlorite, calcium hypochlorite, and chlorinated cyanurate compounds can also be used to chlorinate water. These compounds like chlorine dissolve in water to form hypochlorites ($-OCl^-$) which are strong oxidizers (disinfectants).

Characteristics of Salts of Hypochlorous Acid and other Chlorinating Compounds:

- Salts of hypochlorous acid are more stable than the acid itself. Sodium hypochlorite (NaOCl, common liquid household bleach) is the easiest form of chlorine to inject; volumes required can be accurately measured; there are no residues to clog injection and irrigation equipment and lines. Sodium hypochlorite, like the parent acid (HOCl), has a strong bleaching and germicidal action since it is a powerful oxidizing agent. Powdered calcium hypochlorite, $Ca(OCl)_2$, also called High Test Hypochlorite (HTH), can be used, but it has disadvantages: 1) It may result in formation of other compounds (calcium oxalate, calcium carbonate, and calcium hydroxide) which precipitate during mixing. 2) It is very difficult to determine the exact concentration of the solution being used. 3) The suspended and precipitated material can clog the filters and injection pumps. 4) In order to get a totally clear supernatant, it is necessary to add sodium carbonate which converts the hypochlorite to sodium hypochlorite and precipitates the Ca as calcium

carbonate. 5) HTH can absorb moisture and CO₂ and disintegrate if the container is not airtight. 6) It can be a fire hazard if handled carelessly. HTH can be used, but one must recognize the problems and limitations.

-Sodium dichloroisocyanurate is a slow-release chlorine derivative that maintains excellent bacterial control over an extended period of time. Other organic compounds, such as chloramines, may also be useful.

In deciding whether to use a gas or liquid chlorinator, consider the following: 1) The gas chlorinator can serve but one purpose, chlorination, whereas a positive injection pump or proportioner is multifunctional and can also be used to inject fertilizer solutions, liquid fungicides, herbicides, acids, etc. 2) The capital cost of a gas chlorinator is usually four to ten times the cost of a pump.

Chlorination has been used for destroying microorganisms in water for many years. However, for controlling and eliminating all types of sludges that contribute to clogging of irrigation systems, chlorination is not a "shotgun" solution to all problems: Before using any form of bactericidal chlorine, it is important to be thoroughly familiar with safe-handling techniques for the product, chemistry of the potential reactions, and what is to be achieved.

Additional references:

Ford, Harry W. 1975. The use of chlorine in drip irrigation systems. Proc. Florida State Horticultural Society, 1975, pages 1-4.

Ford, Harry W. 1976. A method for estimating chlorine requirements and an apparatus for controlled chlorine injections in drip irrigation systems. Proc. Florida State Horticultural Society, 1976, pages 21-23.

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