FORMS OF CHLORINE

A. CHLORINE GAS

Pure chlorine gas is dangerous and is supplied in steel cylinders. In this form it can only be added to water with special equipment and knowledge. It is not a practical form for the “field disinfection” of water/environment.

B. CHLORINE SOLUTIONS (LIQUID BLEACH)

These contain chlorine in the chemical form of hypochlorite and are usually prepared from chlorine and caustic soda, thus giving sodium hypochlorite. These solutions are highly alkaline. This alkalinity helps preserve them, but makes them very corrosive.

Fresh solutions can have sodium hypochlorite content up to 15% by weight, but these solutions are highly unstable. They can lose up to 50% of their strength within 60 days in a sealed container. Commercial bleach (Clorox) is 5.25% sodium hypochlorite.

As stated above, sodium hypochlorite is highly corrosive. Special care should be taken in handling because of the risk of contact with skin and eyed in the event of accidental spillage.

C. CHLORINATED LIME

The essential constituent of chlorinated lime is calcium oxychloride, which is decomposed in contact with water to produce calcium hypochlorite. The excess lime, however, is insoluble and must be allowed to settle out before it can be used. Fresh chlorinated lime has approximately 33% available chlorine content and loses strength rapidly unless stored in a cool, dry place.

D. CALCIUM HYPOCHLORITE (HTH)

Calcium hypochlorite is a superior form of solid hypochlorite also known as “HIGH TEST HYPOCHLORITE”. It is produced as a free-flowing granular material. The available chlorine content is between 65-70%. Under normal storage conditions, a loss of strength of only 3-5% occurs, giving a much more satisfactory shelf life than other chlorine products. Until Wysiwash, calcium hypochlorite could not be added to a water line as a solid because its rapid solubility negates the possibility of controlling dosage.

E. CYANURATE-BASED (TCIA) CHLORINE COMPOUNDS

The “cyanurates” find their application predominantly in the swimming pool market. They are not approved anywhere for drinking water or food process water usage. TCIA-based chlorine tablets form an explosive slurry of nitrogen trichloride gas when dissolved in a confined space such as a water line.

CHLORINE CHEMISTRY

When chlorine is added to pure water, it reacts rapidly with water to form hydrochloric (muratic) acid and hypochlorous acid:

$$Cl_2 + H_2O \rightarrow HOCl + HCl$$

When calcium hypochlorite is added to pure water, it also reacts rapidly with water, forming hypochlorous acid and calcium oxide:

$$Ca(OCl)_2 + H_2O \rightarrow 2HOCl + CaO$$

The hypochlorous acid further breaks down to give a hydrogen ion and a hypochlorite ion:

$$HOCl \rightarrow H_+ + OCL-$$

The three forms of chlorine in these reactions, Cl_2, HOCl and OCL-, exist in equilibrium in water. Their relative proportions are determined by two things, pH value and water temperature. For our purposes, the most important overall factor is pH value.

As stated above, pH is the single most important factor in determining chlorine disinfection. Water can be acidic, alkaline or neutral, this is called pH. The "p" is the scientific abbreviation for "HOW MUCH" and "H" is the symbol for Hydrogen. The pH scale is graded from 0 to 14. Pure water is neutral and has a pH of 7. If the pH is above 7, the water is said to be alkaline and the higher above 7, the more alkalinity is present in the water. If the pH is below 7, the water is said to be acidic. The lower below 7, the more acid is in the water.

Since most municipal water treatment systems try to provide drinking water in a range of pH between 7-8, the area in which hypochlorous acid (HOCl) and hypochlorite ion (OCL-) predominate, we do not need to deal with molecular chlorine. Both hypochlorous acid and the hypochlorite ion are disinfectants, but hypochlorous acid is up to 100 times more powerful than hypochlorite ion.