SWIMMING POOL WATER CHEMISTRY FACT SHEET

CHLORINE

The most common chemical used in the treatment of swimming pool water is chlorine. It not only eliminates bacteria and algae by **disinfecting** (killing) action, it also **oxidizes** (chemically destroys) other materials such as dirt and chloramines.

State codes require that chlorine be injected into the pool water through the use of an approved **automatic chlorinator**. When chlorine (in any form) is added to water, a weak acid called Hypochlorous acid is produced. **It is this acid, not the chlorine, which gives water its ability to oxidize and disinfect.** Proper chlorination and filtration give pool water its clear, sparkling appearance.

Chlorine exists as a solid, a liquid and a gas. The strength of each type is determined by the amount of chlorine within the material that is effective both as a disinfectant and an oxidizer.

1. **Liquid chlorine** (sodium hypochlorite) contains 12-16% available chlorine. (By contrast, household bleach generally contains about 5% available chlorine.)

2. **Solid chlorine** (powder or granules)
   A. Calcium Hypochlorite - 65-75% available chlorine.
   B. Chlorinated Isocyanurates - varying percentages of available chlorine.
   C. Lithium Hypochlorite - 30-35% available chlorine.

3. **Gaseous Chlorine** contains 100% available chlorine. This substance is highly toxic and therefore requires special procedures when it is used.

CHLORINE DEMAND and FREE CHLORINE RESIDUAL

As chlorine is introduced into pool water, a portion is always consumed during the processes of disinfection and oxidation. That portion of available chlorine consumed is referred to as chlorine demand.

The hypochlorous acid left after the chlorine demand has been satisfied is referred to as the free chlorine residual. This is what we read when we test the pool for chlorine. **State codes require that the free chlorine residual be at least 1.0 ppm throughout the pool at all times (1.5 ppm if stabilized chlorine is used)**. It is recommended that a residual of 1.5 - 2.5 be maintained with unstabilized chlorine; 2.0 - 2.5 with stabilized chlorine. (See "Cyanuric Acid" description below.)

SUPERCHLORINATION ("Shocking")

Some of the available chlorine will react with nitrogen-containing compounds to form chloramines (combined chlorine). A common source of nitrogen is ammonia, produced from perspiration and urine. Chloramines give off a strong chlorine odor and are irritating to the eyes. **The presence of these two conditions leads many people to believe that there is too much chlorine in the water; actually just the opposite is true.** In order to eliminate the chloramines the pool operator must **raise the chlorine residual to 5 to 10 times the normal level. This procedure, called superchlorination or "shocking", oxidizes the chloramines, leaving only the free chlorine.** Depending on swimmer loads,

it is recommended that a pool be superchlorinated as often as once a week in hot weather and once a month otherwise, in order to control the formation of chloramines. (Note: bathing should be prohibited until normal levels are restored.)

pH

pH is a measure of the acidity or basicity of water and **directly affects some of the chemical reactions that occur in the swimming pool water.** It is measured numerically on a scale from 0 to 14.

Very acidic	Neutral	Very basic (alkaline)
0	7	14

The ability of chlorine to oxidize matter and kill microorganisms is directly affected by pH. As the pH raises this ability is adversely affected. In addition, at a pH over 8.0 scaling (precipitation of mineral components) and cloudy water may result.

As pH falls below 7.0 the acidic condition will cause irritation to the eyes and mucous membranes of swimmers. Low pH (acidic water) can also corrode metal parts of a pool system and damage the plaster finish.

The State standard for pH is 7.2-8.0 (Recommended range 7.4-7.6).

To lower the pH, muriatic (hydrochloric) acid must be added. It is advisable to add the desired amount of acid to a full (plastic) bucket of water before adding to the pool. (Acid introduced directly can stain the pool wall.) **To raise the pH**, soda ash (sodium carbonate) must be added.

ALKALINITY

Alkaline (basic) substances are present in all water. Within the 7.2-7.8 pH range, alkalinity exists as a bicarbonate material. Total alkalinity, as determined with a testing kit, is a measurement of the amount of these substances in parts per million within pools and indicates the water's capacity to withstand changes in pH. The alkaline substances act as buffers, inhibiting changes in pH. Therefore, total alkalinity is a measure of the buffering ability of pool water. The recommended level for swimming pool water is 80-120 ppm.

When pool water is found to be low in alkalinity (below 80 ppm) it is recommended that this level be increased. This can be accomplished with the addition of baking soda using the following formula: 1-1/2 pounds baking soda will raise 10,000 gallons of water 10 ppm.

CYANURIC ACID

The ultraviolet rays of the sun decompose free chlorine. This decomposition can be greatly reduced by "stabilizing" the chlorine through the addition of cyanuric acid.

The level of cyanuric acid in a pool should be routinely measured with a test kit made for this purpose. The recommended level is 20-50 ppm; **levels over 100 ppm will not be accepted.** If levels rise above this point, a portion of the pool water must be removed and fresh water added; **there are no other means of diminishing the cyanuric acid in a pool**.

The stabilizing effect of cyanuric acid does not increase as the levels increase. Instead the chlorine becomes "locked in" at levels over 100 ppm and may not be as effective in killing bacteria and algae. In other words, more is not better.

Often, pools reach excessive levels of cyanuric acid without the pool operator's knowledge. This is because much of the powdered chlorine sold today contains cyanuric acid. If this type of chlorine is used over a long period of time the cyanuric level will become too high. **Pool operators should check to see if the chlorine they are using contains cyanuric acid/stabilizer.** Powdered chlorine containing cyanuric acid will have one of the following active ingredients:

1. Potassium dichloro-s-triazinetrione (potassium dichloroisocyanurate).
2. Sodium dichloro-s-triazinetrione (sodium dichloroisocyanurate).
3. Trichloro-s-triazinetrione (trichloroisocyanurate).

It has been determined that bacteria in the presence of cyanuric acid are destroyed at a slower rate. Therefore, **when a pool has been stabilized the free chlorine residual must be maintained above 1.5-ppm minimum** to offset this phenomenon.

HANDLING AND STORAGE OF CHEMICALS

Care should be taken in the handling and storage of all swimming pool chemicals. The materials should be stored separately from one another and should NEVER be mixed, in order to prevent harmful chemical reactions from occurring. (Pool chlorine and pool acid, if mixed, produce chlorine gas; if inhaled, it can be fatal.)

Chemicals should never be added directly to the pool while it is open for use! Time should be allowed for the chemicals to circulate throughout the pool before allowing swimmers to enter. (This rule does not apply to chlorine introduced through an automatic chlorinator.)

WATER TEMPERATURE

At temperatures above 78 to 82 degrees Fahrenheit, chlorine dissipates faster, algae grows better, and the formation of scale (calcium carbonate deposits) is more likely to occur. There are no State laws regulating swimming pool temperature, but **spa temperature may not exceed 104 degrees Fahrenheit.**