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Fact Sheet

# Cyanuric Acid

## Revised – September 2011

***Brought to you by the APSP Recreational Water Quality Committee***

## I. INTRODUCTION

The purpose of this fact sheet is to provide a generic technical overview of cyanuric acid (CYA), which is marketed for use in stabilizing chlorine in recreational waters.

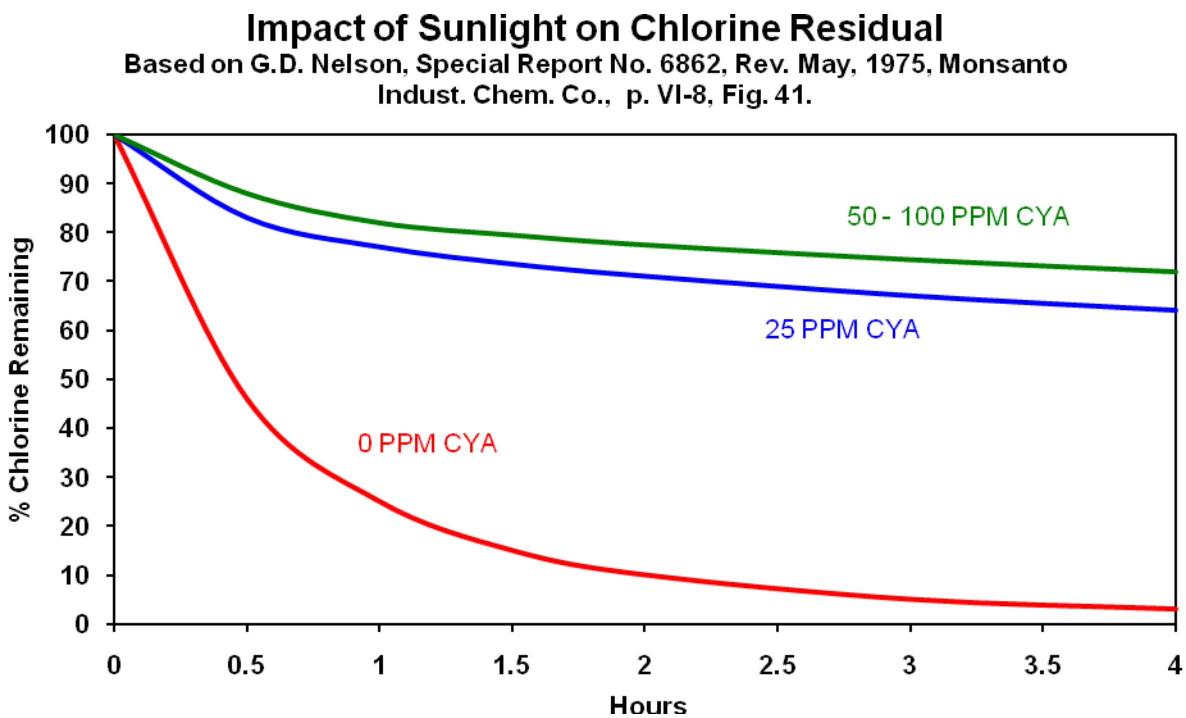
## II. SUMMARY OF CHARACTERISTICS

- Stabilizes chlorine to help prevent degradation of active chlorine by sunlight
- Also commonly known as “stabilizer” or “conditioner”
- May be added to the pool as CYA, sodium salt of cyanuric acid, or as the chlorinated forms of cyanuric acid, sodium dichloro-s-triazinetrione (dichlor) and trichloro-s-triazinetrione (trichlor)
- The effect of cyanuric acid on slowing the oxidation of organics, kill rates of bacteria, viruses, and algae has been demonstrated, primarily in laboratory studies. However, disease outbreaks linked to cyanuric levels in properly sanitized pools have not been reported.
- Cyanuric acid does not stabilize bromine sanitizers
- Cyanuric acid contributes to total alkalinity (See Alkalinity Information Bulletin)

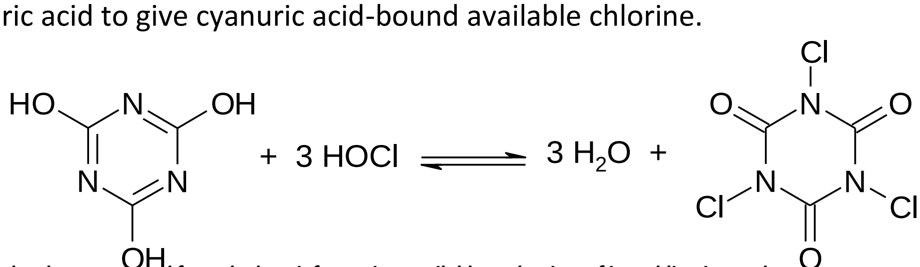
## III. GENERAL DESCRIPTION

Without cyanuric acid in the water, bright sunlight can cause decomposition of most of the chlorine in pool water within an hour, as shown in the graph below. Addition of 25 ppm (mg/L) of cyanuric acid to the water can greatly slow this reduction of chlorine. Maximum stabilization occurs between 50 ppm and 100 ppm. No demonstrable increase in stabilization was seen above 100 ppm. The ideal range for cyanuric acid is 30-50 ppm when used.

Figure 1. Impact of sunlight on chlorine residual




When cyanuric acid is used, hypochlorous acid is always in equilibrium with cyanuric acid-bound available chlorine. As suggested by the equation below, the stabilization of chlorine residual results from a reaction of free chlorine (hypochlorous acid or hypochlorite) with cyanuric acid to give cyanuric acid-bound available chlorine.



This reaction is totally reversible, with a back reaction (to again reform hypochlorous acid) fast enough that cyanurate-bound chlorine tests as free chlorine. Free chlorine that has reacted with cyanuric acid is not permanently lost, but rather placed temporarily in reserve. However the affinity of chlorine for cyanuric acid is strong enough that most of the "Free Available Chlorine" at any given point in time is bonded to cyanurate and the hypochlorous acid concentration is only a fraction of what a free available chlorine test and pH would indicate. This is reflected in an Oxidation Reduction Potential (ORP) that decreases as the cyanuric acid concentration increases as shown in laboratory studies.

Note: A molecule of cyanuric acid can react reversibly with up to three molecules of hypochlorous acid.

Lowering the hypochlorous acid concentration can have a significant impact on the rates of any reaction for which hypochlorous acid is involved in a rate limiting step. Specifically disinfection and oxidation of contaminants can be slowed by the lowered hypochlorous acid concentration.

Generally speaking, the rate of disinfection or the rate of oxidation of a contaminant in the water by hypochlorous acid could be described by the following equation:

$$-dN/dt = k\,[HOCl]^a\,N$$

in which:

- N represents a microbial concentration (such as deduced by a plate count) of the microbe to be killed or the concentration of the oxidizable species (such as various organic compounds, breakpoint susceptible chloramines, sulfide, or nitrite) to be destroyed;
- –dN/dt represents the rate of loss of the microbe or oxidizable material;
- k represents a rate constant; a is a positive real number that is specific to the type of reaction involved; and
- [HOCl] represents the hypochlorous acid concentration.

If this rate dependence on hypochlorous acid concentration is considered with the following equilibrium, it can be seen that increasing cyanuric acid will decrease the HOCl concentration which could have a negative impact on sanitization and oxidation rates.

$$HOCl + CYA \rightleftarrows CYA - Cl + H_2O$$

The effect of cyanuric acid on oxidation of organics, kill rates of bacteria and viruses, algae, and protozoa has been demonstrated. Some authorities or standards have suggested adjusting the required chlorine residual to the concentration of cyanuric acid to compensate for the reduction in rates of kill. These studies are not fully comprehensive and applicability to real pools has not been demonstrated. Specifically, we do not have any empirical evidence that a disease outbreak has been linked to a particular cyanuric acid level in a properly sanitized pool (i.e., when at least 1 ppm free available chlorine was present in the pool).

## IV. APPLICATION

Application methods will depend upon the product form being used. Cyanuric acid is available in both granular and liquid slurry forms. Since the granular form is slow to dissolve, if it is fed into the skimmer, care must be taken to feed the product slowly to avoid blocking the lines. Most granular cyanuric acid products are approximately 100% active. The following table summarizes the cyanuric acid contributions from dichloro-s-triazinetrione and trichloro-s-triazinetrione.

Pounds of cyanuric acid contributed to the pool for every pound of product:

| Product | One pound product contains x pounds of cyanuric acid |
|---|---|
| Sodium dichloro-s-triazinetrione | 0.58 |
| Sodium dichloro-s-triazinetrione dihydrate | 0.50 |
| Trichloro-s-triazinetrione | 0.55 |

Dosage and application requirements will be explained on each product label.

When used, the ideal range for cyanuric acid is 30 – 50 ppm. The concentration should not exceed 100 ppm. Cyanuric acid is not recommended for indoor pools or spas where protection from sunlight is not necessary.

The 100 ppm limit is a common consensus among health authorities, for example:

| | |
|---|---|
| CDC | 100 ppm |
| WHO | 100 ppm |
| Ten State Standard | 100 ppm |

There is a degree of uncertainty in setting this value, but the consensus decision is not entirely arbitrary. The following factors were considered when setting the limit for cyanuric acid:

- Effective use levels of cyanuric acid;
- Cyanuric acid/chlorine equilibria;
- Effect of cyanuric acid on Oxidation Reduction Potential (ORP); and
- Effect of cyanuric acid on chlorine kill rates.

Test kits and strips are available for testing the cyanuric acid concentration to ensure that it is within the proper range.

If the cyanuric acid concentration needs to be reduced the following approaches may be used:

- Partially drain and refill the pool
- Increase backwash times or frequency
- Follow appropriate water replacement intervals

## V. PRECAUTIONS

In order to safely use and handle cyanuric acid products, all individuals involved in their manufacture, distribution, sale, or use should be trained and knowledgeable about their properties. Safety information is available on the product label, product MSDS (Material Safety Data Sheet), and manufacturer's training materials. This safety information will include disposal instructions, instructions on disposal of the package, and spill response information.

For safety and handling information for stabilized chlorine compounds, refer to manufacturer's labels and appropriate Information Bulletins. Cyanuric acid is stable when stored in a cool, dry, ventilated area and not contaminated by other chemicals such as bases or chlorinated pool chemicals. Cyanuric acid, dichloro-s-triazinetione and trichloro-s-triazinetrione, in the solid form or in concentrated solutions, shall not be mixed with other pool chemicals including other chlorinating agents. Partially empty packages must not be consolidated, as this could result in dangerous mixing with incompatible dry chlorinating agents having a similar appearance.

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