APSP The Association of Pool & Spa Professionals®

REFLECT SUCCESS

Fact Sheet

Alkalinity

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Brought to you by the APSP Recreational Water Quality Committee

I. INTRODUCTION

This fact sheet discusses alkalinity, its relationship to water balance for pools and spas, and how it is measured and controlled.

II. SUMMARY OF CHARACTERISTICS

Total alkalinity is determined by the amount of bicarbonate, the much smaller amount of carbonate, and in stabilized pools, the amount of cyanurate ions. It is a measure of the pH buffering capacity of water; that is, the ability of water to resist a pH change. Alkalinity is generally expressed in terms of the equivalent concentration of calcium carbonate in ppm.

Total alkalinity is a key parameter in the maintenance of water balance. The proper total alkalinity level in pool or spa water provides buffering so that pH does not swing in and out of the proper range in response to sanitizer addition, bather load or other factors. With too little alkalinity there will not be enough buffering and the pH may quickly drift out of the proper range. At excessively high bicarbonate/carbonate alkalinity there will be a tendency for the pH of the water to drift upward, due to the rapid escape of carbon dioxide from the water into the air.

The portion of the alkalinity coming from carbonate and bicarbonate, called carbonate alkalinity, also affects calcium carbonate saturation. The maintenance of calcium carbonate concentration within the recommended range reduces the tendency of pool water to scale or degrade pool surfaces.

When total alkalinity is properly adjusted, optimum buffering results are achieved; pH, swimmer comfort, sanitizer efficacy, water balance, and clarity are more easily maintained.

III. GENERAL DESCRIPTION

ANSI/APSP-11, the American National Standard for Water Quality in Public Pools and Spas states that total alkalinity shall be maintained between a minimum 60 and a maximum of 180 ppm as $CaCO_3$. Ideally, total alkalinity should be maintained between 80 and 100 ppm as $CaCO_3$ where electrolytic chlorine generators, calcium hypochlorite, lithium hypochlorite, and sodium hypochlorite are used, because these sanitizers cause the pH to rise. The ideal range where sodium dichlor, trichlor, chlorine gas and bromine compounds are used is between 100 and 120 ppm as $CaCO_3$, because these sanitizers will cause the pH to drift downwards. Certain systems such as PHMB are relatively unaffected by and do not impact total alkalinity.

IV. APPLICATION

Total alkalinity is most often measured using testing kits or test strips. Total alkalinity should be corrected before adjusting pH or sanitizer levels. (See notes below to regarding Adjusting for the Effect of Cyanuric Acid on Total Alkalinity)

To reduce total alkalinity, acid is added to the water. Approximately 2.1 pounds of sodium bisulfate (94%) or 1.6 pints of muriatic acid (31%) will reduce the total alkalinity of 10,000 gallons of water by 10 ppm.

Sodium bicarbonate is used to increase total alkalinity. Approximately 1.5 pounds of sodium bicarbonate (100%) will raise the total alkalinity of 10,000 gallons of water by 10 ppm.

Adjusting for Effect of Cyanuric Acid on Total Alkalinity:

Dichlor and trichlor sanitizers release cyanuric acid which serves to stabilize the chlorine sanitizer. Cyanuric acid stabilizer may be added separately as well. The cyanurate system is a weak buffer and will contribute to the total alkalinity measurement.

To determine the carbonate alkalinity:

1. Measure the pH
2. Measure total alkalinity (Measured TA)
3. Measure cyanuric acid concentration (CA). If the CA is 90ppm or greater, it may be necessary to dilute the pool water sample with tap water to get an accurate reading.
4. Note the Cyanuric Acid Correction Factor in Table 1, based on the pH of the water.
5. Adjust the CA and subtract this result from the total alkalinity for the actual or corrected TA.
6. Formula : Measured TA – (CA x Cyanuric Acid Correction Factor) = Carbonate Alkalinity

Table 1

Cyanuric Acid Correction Factor	
pH	Factor
7.0	0.23
7.2	0.27
7.4	0.31
7.6	0.33
7.8	0.35
8.0	0.36

Example:

pH is 7.4. Total Alkalinity measurement (Measured TA) is 110 ppm. Cyanuric Acid level is 100 ppm.

Cyanuric Acid Correction factor at pH 7.4 is 0.31. (From Table 1)

Using the formula:

110 ppm – (100 x 0.31) = 110 – 31 = 79 ppm carbonate alkalinity

V. PRECAUTIONS

Follow all label directions regarding safe storage and handling of any chemical products.

VI. REFERENCES

1. The Association of Pool and Spa Professionals “APSP Service Tech Manual, Basic Pool & Spa Technology,” The Association of Pool and Spa Professionals Third Edition. , Alexandria, Virginia
2. The Association of Pool and Spa Professionals “Chemical Operational Parameters.” The Association of Pool and Spa Professionals, Alexandria, Virginia.
3. Wojtowicz, J.A. “Treatment of Swimming Pools, Spas, and Hot Tubs”. Kirk –Othmer Encyclopedia of Chemical Technology, Fourth Edition, Vol. 25, New York, NY. John Wiley and Sons, Inc., pp 569-594, 1998
4. Wojtowicz, J.A. “The Carbonate System in Swimming Pool Water” Journal of the Swimming Pool and Spa Industry, 3(1)(2001):54-59