



Alkalinity

ALKALINITY AND ITS ROLE IN WATER BALANCE FOR POOLS AND SPAS

By the APSP Recreational Water Quality Committee (RWQC)

WHAT IS TOTAL ALKALINITY?

Total alkalinity is the amount of bicarbonate, plus the much smaller amount of carbonate, plus (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.

Balancing pool and spa water is perhaps the fundamental job of the service pro, and total alkalinity is a key parameter in that process.

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.

In addition to these effects on pH, 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.

How To Adjust

Total alkalinity should be corrected before adjusting pH or sanitizer levels. (See notes below 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 percent) or 1.6 pints of muriatic acid (31 percent) will reduce the total alkalinity of 10,000 gallons of water by 10 ppm.

To increase total alkalinity, use sodium bicarbonate. Approximately 1.5 pounds of sodium bicarbonate (100 percent) 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 in a stabilized pool or spa:

1. Measure the pH
2. Measure total alkalinity (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 : $\text{Measured TA} - (\text{CA} \times \text{Cyanuric Acid Correction Factor}) = \text{Carbonate Alkalinity}$

pH	Correction 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. (See table above)

Using the formula:

$110 \text{ ppm} - (100 \times 0.31) = 110 - 31 = 79$ ppm carbonate alkalinity

THE RIGHT AMOUNT OF TA

Total alkalinity should be maintained between a minimum 60 and a maximum of 180 ppm as CaCO₃ (calcium carbonate). Ideally, total alkalinity should be maintained between 80 and 100 ppm as CaCO₃ 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 CaCO₃, 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.

REFERENCES

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