

# A Deeper Look at Alkalinity

*onBalance – Que Hales, Doug Latta and Kim Skinner*

Of all water balance parameters, “alkalinity” may be the least understood. Alkalinity is what helps maintain a proper pH (from 7.2 to 7.8), and buffers, or resists wild pH fluctuations when sanitizers or other chemicals are added to pool water.

Sanitizers, when added to water, in addition to providing chlorine, also have an acidic (acid or low pH) or an alkaline (basic or high pH) effect on the water. It is the alkalinity (primarily in its bicarbonate form) that reacts with and “absorbs” the pH-altering effect of the sanitizer. This process “buffers” the pH, but may also either add to or lower the total amount of alkalinity in the water. Adding other types of chemicals also may have an effect on pH, and those effects are also “buffered” by the alkalinity.

The APSP has established that pool water should have a minimum of 60 ppm and a maximum of 180 ppm of total alkalinity. If the total alkalinity is below 60 ppm, there may not be enough alkalinity (buffering capacity) to resist a significant pH change if an acidic or basic chemical is added. In the case of adding an acid, the pH could drop below 7.0, making the water very corrosive to pool plaster, metal fixtures and equipment, as well as being very irritating to swimmers’ eyes. In the case of adding a high pH (alkaline) chemical, the pH could go excessively high (over 8.3), which increases the likelihood of calcium carbonate (scale) depositing onto the pool surface and equipment.

The reason for a maximum level of total alkalinity is due to the fact that a level higher than 180 ppm also increases the possibility of scale forming. An exacerbating factor is that higher bicarbonate alkalinity can cause a more rapid upward drift in pH, due to the gradual loss of carbon dioxide from the water. It should be understood that an alkalinity below 60 ppm or above 180 ppm does not necessarily mean that a corrosive or a scaling condition is imminent, only that the possibility of this condition is more likely. Other water balance parameters such as pH, calcium, and temperature may be able to counterbalance the out of range alkalinity level, although this is not a recommended way of maintaining water balance.

A low total alkalinity level can be quickly corrected by the addition of sodium bicarbonate (baking soda). Sodium bicarbonate increases the alkalinity level without affecting the pH significantly. Sodium carbonate (soda ash) also increases the alkalinity, even more than sodium bicarbonate (pound for pound). However, it may also raise the pH too high.

Too high of an alkalinity level can be corrected by adding muriatic acid or dry acid (sodium bisulfate), but will take more time because the acid has to be added slowly and in small increments.

**Important Note:** In regards to lowering alkalinity, there is **NO** truth to the concept that pouring acid in one spot of the pool (the column or “slugging” method) will result in a

greater reduction of alkalinity than distributing the acid evenly around a pool. No matter how acid is added to the pool, it will always have the same effect on the alkalinity, as well as the pH. When manually adding acid to a pool, it is important to always dilute the acid and trickle it into the pool by walking around the perimeter. Acid is heavier than water and will sink to the lowest area of the pool, with the potential to damage (etch) the plaster surface, as well as the equipment if drawn in by the pump system. Pool operators should never pour undiluted acid into one area of the pool.

It should be understood that neither low total alkalinity (below 60 ppm) nor higher levels than 180 ppm will detrimentally affect the efficacy of chlorine or other types of sanitizers. As long as the pH is in the range of 7.2 to 7.8, the sanitizer will still be able to effectively destroy bacteria and algae and keep the pool safe to swim in. Unless the pool is cloudy, there is no need for Health Inspectors to close the pool just because the alkalinity is out of range. As mentioned above, simple steps can be taken to correct the out of range alkalinity content.

The one unfortunate aspect regarding alkalinity is that when total alkalinity is in the proper operating range of 60 ppm and 180 ppm, it causes the pH to seek a natural level of about 8.0 to 8.3. Consequently, acid is needed to constantly lower the pH back to the operating parameters of 7.2 to 7.8. Periodic additions of sodium bicarbonate are needed to replenish the alkalinity lost due to acid addition. Another approach to pH control is to add carbon dioxide, rather than acid, for pH control. In such a case regular alkalinity replenishment may not be required.

Adding carbon dioxide lowers the pH, but does not affect the total alkalinity content. The loss of carbon dioxide increases the pH toward 8.4, and also does not affect total alkalinity.

If pool water contains cyanuric acid (from the addition of Trichlor and Dichlor, or from direct additions), it also contributes to the total alkalinity. This is why the term “total alkalinity” is used when discussing pH buffering capabilities and for establishing the minimum and maximum levels. However, the alkalinity contributed by cyanuric acid is not a “carbonate” type of alkalinity, which is the type of alkalinity needed to determine proper water balance using the Langelier Saturation Index (LSI). “Carbonate” alkalinity consists of bicarbonate and carbonate ions. Sodium bicarbonate, sodium carbonate, and sodium hydroxide are chemicals that can be added that contribute to “carbonate” alkalinity.