MISSISSIPPI STATE UNIVERSITY EXTENSION

Total Alkalinity

Total alkalinity is the total concentration of bases in water expressed as parts per million (ppm) or milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$). These bases are usually bicarbonates (HCO_3) and carbonates (CO_3), and they act as a buffer system that prevents drastic changes in pH. For example, in waters with low alkalinity, pH might fluctuate from 6 or lower to as high as 10 or above; while in high-alkalinity waters, pH might fluctuate from about 7.5 to 8.5.

Greater production in bass-bluegill ponds is attained in high-alkalinity waters because this pH buffering capacity makes phosphorus and other essential nutrients more available to the algae bloom.

Total alkalinity is not the same as hardness. Calcium (Ca^{++}) and magnesium (Mg^{++}) are primarily responsible for hardness. However, in most waters, alkalinity and hardness have similar values because the carbonates and bicarbonates responsible for total alkalinity are usually brought into the water in the form of calcium carbonate or magnesium carbonate. Waters with high total alkalinity are not always hard since the carbonates can be brought into the water in the form of sodium or potassium carbonate.

Improving Alkalinity

The most common method of increasing alkalinity in waters is by adding agricultural limestone (calcium carbonate). Fish managers in Europe and Asia have reported that applications of lime to fish ponds on soils of low calcium content resulted in greater fish production. Fish managers in the United States showed that applications of lime to lakes increased pH and total alkalinity and also cleared water of brown stain from humic substances. Clear water results in deeper light penetration and greater photosynthesis, as well as increased zooplankton production.

Fertilization does not produce adequate phytoplankton (algae bloom) in many ponds with soft waters and acid muds because carbon dioxide is in short supply, and added phosphate adheres tightly to the bottom muds. Addition of lime to these ponds elevates total bicarbonate alkalinity and increases pH in the water. Neutralization of bottom muds with lime prevents phosphate from adhering to it, thereby increasing phosphorus concentrations in the water. As a result of these changes in water quality, phytoplankton blooms develop upon application of inorganic fertilizers. Liming soft water ponds to increase alkalinities to at least 20 ppm is beneficial to fish production.

As a general rule, ponds with alkalinities less than 20 ppm do not respond well to fertilization and should be limed in the fall before springtime fertilization is initiated. Liming ponds with alkalinities greater then 20 ppm typically will not increase the response to fertilizer. It does, however, increase the alkalinity and pH buffer capacity.

Copper Sulfate Treatment Dependent on Total Alkalinity

Copper sulfate ($CuSO_4$) is used commonly in fish culture ponds to treat for weeds and algae; it must be applied at a rate dependent on the total alkalinity of the water. At lower alkalinities, copper becomes more toxic; it should not be used at alkalinities below 50 ppm. Conversely, copper sulfate becomes ineffective at alkalinities above 300 ppm. Fish can be killed if treatment rates in parts per million of copper sulfate exceed total alkalinity divided by 100. On the other hand, treatments at lesser concentrations are ineffective. For effectiveness against weeds and algae, you must apply sufficient amounts of copper sulfate relative to the amount of carbonates in the water. If too much carbonate is present in the water, relative to the amount of copper sulfate added, the copper (Cu^{++}) will settle out as copper carbonate and will not be available in the water to treat the problem.

Total alkalinity divided by 100 is the rate in parts per million at which copper sulfate should be applied.

Example

Water from a 15-acre pond (averaging 4 feet deep) measures 171 ppm total alkalinity. 171 ppm total alkalinity divided by 100 = 1.71 ppm copper sulfate to be used in this pond. This answer is then used in the following formula to determine pounds of copper sulfate to use:

Pond water acres × depth in feet × ppm copper sulfate × 2.72 pounds of copper sulfate per 1 acre-foot per 1 ppm

The pounds of copper sulfate needed in this pond would be:

15 acres × 4 feet × 1.71 ppm copper sulfate × 2.72 =
279 pounds of copper sulfate

Publication 3776 (POD-09-21)

Distributed by **Wes Neal**, PhD, Extension/Research Professor, Wildlife, Fisheries, and Aquaculture. Adapted from a publication by Dr. Robert Durborow.

MISSISSIPPI STATE UNIVERSITY™
EXTENSION

Produced by Agricultural Communications.