TREATING HIGH BICARBONATE WATER

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In order to discuss how to treat high bicarbonate water, it is necessary first to define what constitutes high bicarbonate water or what is high bicarbonate water. First of all, a bicarbonate is a salt obtained by the neutralization of one hydrogen in carbonic acid. Carbonic acid (H_2CO_3), in turn, is a solution of carbon dioxide (CO_2) in water (H_2O). There are two replaceable hydrogen ions in carbonic acid (H_2CO_3). The salts obtained by neutralizing only one hydrogen are called bicarbonates.

Examples: $CaHCO_3$—calcium bicarbonate;
$NaHCO_3$—sodium bicarbonate

Carbonates can be converted into bicarbonates by adding excess carbon dioxide. Example:

$$Na_2CO_2 + CO_2 + H_2O = 2NaHCO_3$$

Sodium carbonate + CO_2 + water = sodium bicarbonate

What problems does it cause? The most common problem associated with high levels of bicarbonate is that of unsightly deposits or precipitates on plant foliage. This problem lowers the visual quality of nursery stock, and thus can affect its salability.

Following closely behind this problem is the fact that, with the evaporation of water, calcium and magnesium carbonates form and can, and often do, plug small-orifice irrigation equipment.

Other problems that can occur, but usually are of less significance are: toxicity to the roots of some species of plants, increased sodium uptake by plant foliage due to imbalances in calcium and magnesium levels in relationship to sodium levels, and a gradual rise in soil pH from carbonate accumulation.

How can the water be treated? The most common treatment for high carbonates is to inject an acid directly into the water to neutralize the carbonates. This method has been used since the late 1950s and has proven to be the most cost-effective method of dealing with the problem.

Along with the sought-after benefit of neutralization of the carbonates, acid injection also allows for the introduction of one or more anions for plant nutrition purposes without appreciably increasing the salinity of the water. At Greenleaf Nursery we get sulfates as a side benefit to acid injection.

There are three acids that are usable for this purpose. The first of these is phosphoric acid, which is available in either a 75 or 85 percent concentration. When using by-product phosphoric acid one needs to be cautious as this grade of acid sometimes contains heavy metal contaminates, such as arsenic and chromium. Thus, it is much safer to use food-grade phosphoric acid, which is relatively expensive. This acid is, however, the least dangerous of the acids to handle.

Sulfuric acid has the inherently bad quality of being dangerous to handle, but it also is the most cost-effective. If this acid is to be used, the purer the concentration, the safer it will be to handle (66° Baume/98%). The approximate cost at Greenleaf Nursery to treat 1,000 gallons of water with sulfuric acid is approximately three cents. This cost, however, is only a materials cost and does not factor in the capitalization of the equipment.

The final acid I will mention is nitric acid. This acid has a nitrogen analysis of approximately 15-0-0 and thus would supplement your nitrogen feeding. However, this acid is not available; it is the most corrosive and, consequently, the most dangerous to handle.

There are other possibilities that might be worth the effort to explore when deciding on a treatment plan. One of these products goes by the trade name of Sequest-All and is said not only to do a good job with this problem but also to be very safe to handle. Equipment costs would most likely be much reduced with a product such as this due to its relatively non-corrosive nature.

Problems and cautions concerning injection of acids: safety is of major concern with the handling and injection of any acid. Thus, it is highly advisable when planning an injection system that you enlist the services of a licensed professional engineer for the planning stage to insure that the system is properly designed and equipment properly selected to meet all safety requirements. Users should also consult with OSHA and other regulatory agencies for updated information regarding safety requirements. Sulfuric acid is on the EPA's extremely hazardous list. This means that currently it has to be reported under the new "right-to-know" laws if your supply exceeds certain "threshold planning quantities" as specified under the law. Also, it is always advisable to remember that acid can be added to water, but not water to acid. The latter reaction generates a great deal of heat and, if the heavier acid is on top, there is much less chance of splattering.

To estimate the quantity of acid required, one can follow these simple steps.

Obviously your first step is to have a reputable laboratory complete an agricultural-suitability analysis. From this information you can determine the meq./L of carbonates present. This is simply done by adding both the bicarbonates and the carbonates together. Then subtract two from the resulting sum of the carbonates. This number can then be multiplied by the "acid factor" to determine the quantity of acid required to treat 1,000 gallons (1).

Equipment needed: The equipment required to treat water with acid varies greatly with each situation. It can range from such simple equipment as a safe, spill-proof container used to pour acid directly into a water reservoir—all the way to sophisticated flow measuring and injecting equipment.

At this point in your planning it is highly beneficial to have employed the services of a licensed professional engineer to assist in the design work and the selection of proper equipment to fit your particular needs.

CONCLUSIONS

It is not only possible but also practical and cost-effective to treat high-bicarbonate water to improve its quality. This undertaking, however, requires a careful plan to maintain proper safety as well as considerable knowledge of types and sizes of injection equipment available. For these reasons, I think it is ill-advised to proceed with a treatment plan without consulting a professional engineer who is familiar with this type of work.

LITERATURE CITED

1. Soil and Plant Laboratory Form #426. Mineral acid treatment of irrigation water for quality improvement and reduction of small orifice plugging. Soil and Plant Laboratory, Box 153, Santa Clara, CA., 95052.
2. Soil and Plant Laboratory Form #441. Calculation factors for use in mineral acid water treatment. Soil and Plant Laboratory. Box 153, Santa Clara, CA., 95052.

CALCIUM, MAGNESIUM, AND IRRIGATION WATER

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For years great emphasis has been placed on "proper pH" of container growing media, and dolomite (calcium and magnesium carbonate) has been used almost exclusively to raise the pH to the chosen level (1, 2). As nutrition in containers becomes more precise, calcium and magnesium nutrition must be modified. Many irrigation waters contain substantial quantities of dissolved calcium and magnesium. Whitcomb (4,5) studied this extensively in Oklahoma and found that with a water that contained 40 ppm calcium and 17 ppm magnesium, two pounds of dolomite was