SOIL BUFFER pH

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Concern is being expressed these days regarding soil buffer pH. This is particularly true for sand-based golf putting greens and tees. What is the nature of this concern? In order to answer this question we first need to review soil pH, acidity and pH buffering.

Soil pH is measured by immersing an hydrogen ion sensitive glass electrode in a soil-liquid suspension and reading the pH on a meter. The reading obtained depends on the ratio of soil to liquid used in preparing the suspension and the composition of the liquid. The greater the ratio of soil to liquid, the lower the pH reading. Likewise, the higher the soluble salt content of the liquid used, the lower the pH reading.

Different soil testing labs use different soil to liquid ratios. Some measure soil pH in pure water while others use a dilute salt solution. Therefore, a sure-fire way to get confused or lose faith in soil testing is to send your samples to more than one laboratory. Chances are the results won't be the same, even for something so simple as soil pH.

When soil pH is measured in a dilute salt solution, it is referred to as "salt" pH, but you probably won't be told this on your soil test report. Why is salt pH lower than soil pH in pure water? The reason is that positively charged ions in the salt solution displace a small amount of hydrogen ions from soil particle surfaces into solution. These hydrogen ions are then sensed by the glass electrode. This brings us to the correct concept of soil pH. It is a measure of hydrogen ions actually in solution. Soil pH does not measure hydrogen ions chemically bonded to soil particles.

Why do some labs measure soil pH in a salt solution rather than pure water? These are the labs that recognize that water in soil always contains dissolved inorganic and organic substances. In essence, soil solution is a dilute salt solution. Measuring soil pH in a dilute salt solution mimics the true situation in the soil much better than does pH measured in pure water.

The numbers of hydrogen ions that exist in soil solution at any given time are but a tiny fraction of the chemically reactive hydrogen ions actually present. A preponderance of the reactive hydrogen is chemically bonded to soil constituents and to organic matter in particular.

There exists in soil a unique relationship between hydrogen ions in soil solution and the reactive hydrogen ions bonded to organic compounds. This relationship gives rise to what is known as soil pH buffering. What the term "pH buffering" means is that the soil has ability to resist in change in pH.

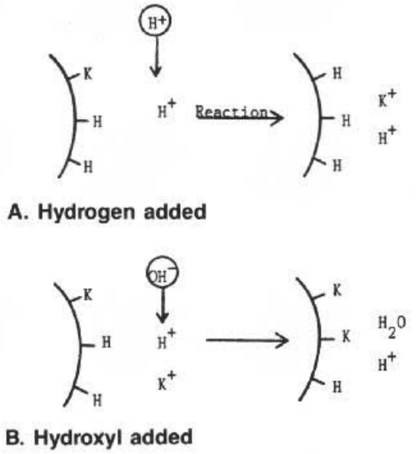


FIGURE 1. Illustration of the pH buffering action of soil.

To understand how soil pH buffering works, look at Figure 1 and imagine two things happening: (1) first, hydrogen ions (H+) are added to the soil solution; and (2) second, hydroxyl (OH−) ions are added. When hydrogen ions are added, some of those already in solution bond to organic matter, thereby keeping the solution concentration of the hydrogen ions fairly constant. This response "buffers" soil against a reduction in pH. When hydroxyl ions are added to soil solution, the reactions are a bit different but the net result is the same. The hydroxyl ions chemically combine with hydrogen ions in the soil solution to form water molecules. This would raise soil pH if it were not for the fact that as the hydrogen ion concentration is reduced by reacting with the hydroxyl ions; the reacted hydrogen ions are replaced in solution by hydrogen ions bonded to the organic matter. Thus, the solution concentration of the hydrogen ions has been "buffered" by the soil and pH remains relatively unchanged.

Soils do not have unlimited pH buffering capacity. If they did, we could adjust the pH just once and never worry about it again. As this buffering capacity is exceeded through continuous additions of acids or bases, the soil pH begins to change and the soil becomes acid or alkaline. The smaller the pH buffering capacity of a soil, the more quickly its pH changes over time.

So what determines the pH buffering capacity of soil? Below a pH of 5.5, aluminum ions can be a contributing factor. However, at all pH levels the primary source of pH buffering is organic matter. The greater the amount of organic matter present in soil and the greater its degree of decomposition, the higher the pH buffering capacity of soil.

Herein lies some concern about sand-based golf putting greens and tees. *Sand itself has virtually no pH buffering capacity. The pH of pure sand is essentially uncontrollable and fluctuates widely, even within a single growing season.*

The pathway here has been fairly long, but the stage is now set to talk about soil buffer pH. Many years ago soil scientists saw the need to devise a rapid means for estimating the amounts of acidity in soils. These estimates are required to arrive at accurate liming recommendations.

The technique developed for quickly estimating the amount of acidity in soil involved measurement of soil pH in a solution that itself is highly pH buffered. This buffered solution is first adjusted to a fixed pH. When added to soil, the buffered solution reacts with soil acidity and the pH of the soil-buffer solution suspension decreases in accord with the amount of acidity in the soil. Hence, the amount by which the pH of buffered solution is decreased is directly related to the soil's acidity (see Figure 2) and to the amount of liming material needed to adjust the soil pH.

So what is soil buffer pH? It is an estimate of how much acidity resides in the soil. This, in turn, depends on the existing pH of the soil and the amount and nature of the organic matter present. Soil buffer pH is not a measure of actual soil pH. In fact, two very different soils can very well have the same pH but quite different buffer pH

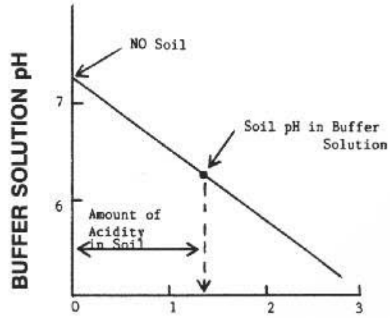


FIGURE 2. Illustration of how soil pH in a buffer solution estimates soil acidity.

values. This is illustrated in Figure 3. Soil A with 1% organic matter and soil B with 5% organic matter have the same pH but very different buffer pH values.

This returns us to the question posed earlier: why the recent concern about soil buffer pH? Very frankly, I don't know. Soil buffer pH is not the actual pH of soil and, in and of itself, conveys no useful information to you other than a general sense of how much acidity is present. What's important for you to know is salt pH. This is the best estimate available of the actual pH of your soil.

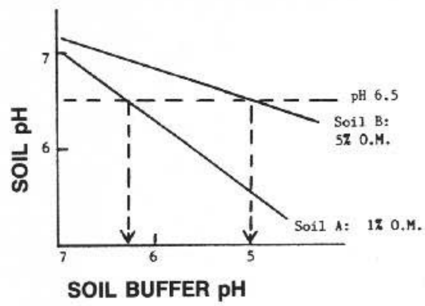


FIGURE 3. Illustration of how two soils with the same pH can have different buffer pH values due to difference in organic matter (O.M.) contents.

GCSAA Recognizes *THE GRASS ROOTS* with "Best Editorial" Award!

For the seventh consecutive year, the Golf Course Superintendent Association of America has presented *THE GRASS ROOTS* an award in its annual editor's contest.

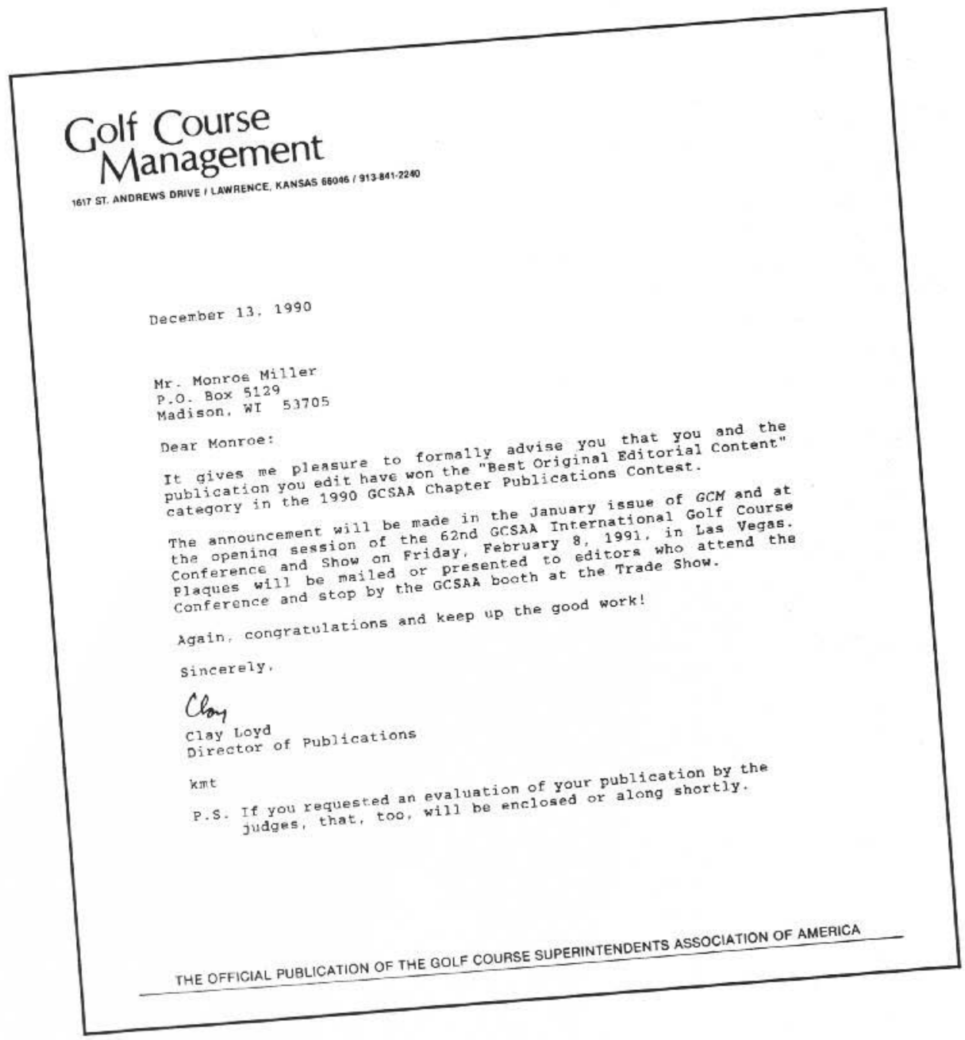
The 1990 award is for "best original editorial content", a category that our journal has captured several times before.

The contest award is, obviously, a focus on original writing. Personally, this category is the one coveted by this editor.

The credits are well documented in the new feature in this issue—the 1990 article index. The authors noted there earned the recognition for the new and fresh and timely material which contributed so much to the award.

The evaluation, requested by this editor, has many points that received high grades that only our printer could be responsible for: things like layout and design, photo placement, and typesetting. The entire staff at Kramer Printing in Madison contributes; special thanks to Sherri Livernash Milani of the art department. Her talent and concern are evident in every issue.

On the right is the letter from GCSAA headquarters notifying us of the results of the contest. Read and enjoy!



Golf Course Management

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December 13, 1990

Mr. Monroe Miller
P.O. Box 5129
Madison, WI 53705

Dear Monroe:

It gives me pleasure to formally advise you that you and the publication you edit have won the "Best Original Editorial Content" category in the 1990 GCSAA Chapter Publications Contest.

The announcement will be made in the January issue of *GCM* and at the opening session of the 62nd GCSAA International Golf Course Conference and Show on Friday, February 8, 1991, in Las Vegas. Plaques will be mailed or presented to editors who attend the Conference and stop by the GCSAA booth at the Trade Show.

Again, congratulations and keep up the good work!

Sincerely,

Clay

Clay Loyd
Director of Publications

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P.S. If you requested an evaluation of your publication by the judges, that, too, will be enclosed or along shortly.

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