

Are bicarbonate and sodium killing your putting greens?

August 13, 2020

The answer is simple, **NO**.

There is a widespread fear that high levels of bicarbonates and sodium in irrigation water will reduce water infiltration in golf putting greens and other sand-based sports turf. It's believed that these issues slow water infiltration and drainage and ultimately kill the roots and turfgrass plants.

While high soil sodium and bicarbonate levels in some soils can cause drainage issues, it simply isn't the case for sand-based and highly modified turfgrass soils. Here's why:

High soil sodium: High sodium concentrations (>5% of the total cation exchange capacity of the soil) can definitely cause problems in native soils with high levels of silt and clay. These soils can become well-drained when individual soil particles form aggregates (soil clods or chunks). The spaces formed between these soil aggregates, called macropores, allow for rapid infiltration and drainage. A high exchangeable sodium percentage (ESP) in these soils can cause these aggregates to breakdown and for the soil to swell. This dramatically reduces soil drainage. The solution to high ESP is the addition of gypsum (CaSO_4) and leaching irrigation. The gypsum displaces the sodium and the leaching irrigation pushes the sodium below the root zone.



Figure 1. An example of angular blocky soil structure. Photo courtesy of www.nrcs.usda.gov.

Sand soils do not form soil aggregates. That means that sodium cannot destroy the soil structure of sand-based greens because there isn't any structure to begin with. Sands are well-drained because the large particles naturally form macropores. **Adding gypsum or other calcium containing product will NOT help these soils.**

High levels of sodium and other salts like calcium, potassium, nitrate, etc. can lead to salinity stress. This stress can be measured with a simple Soil Electrical Conductivity (EC) measurement in a lab. If the value exceeds 3 dS/m, then leaching may be required. Adding calcium-based products like gypsum to these will actually make the situation worse because these products are themselves salts.

Here's more info about this: <https://www.golfdom.com/sand-greens-and-sodium/>

High Bicarbonate: There is this widespread fear that high bicarbonate levels in irrigation water have the potential to reduce water infiltration in putting greens. As a result, there are numerous products marketed to improve water infiltration and drainage at facilities with high bicarbonate levels in the irrigation water.

The supposed issue is that bicarbonate from irrigation water is forming calcium carbonate which is plugging up the soil macropores. This issue can occur in fine textured soils with very high pH in the desert southwest, but turfgrass research results tell another story in putting greens and other sand-based root zones.

Nebraska Ph.D. student, Glen Obear, studied this soil issue during his M.S. degree with Dr. Doug Soldat at UW-Madison. They irrigated turf with water containing extremely high levels of bicarbonate (91,500 ppm) for **two and a half years**. They only added enough water to replace what was lost during transpiration. They never observed a reduction in infiltration rate or the formation of a carbonate crust.

After visiting golf courses with possible carbonate surface layers, the researchers found that those white colored layers were the formation of calcium carbonate sitting on top of another layer: algae! More information can be found in this USGA update: <https://archive.lib.msu.edu/tic/usgamisc/ru/w-2014-12-02.pdf>

Infiltration rate of putting greens can decline during the summer, but it isn't because of sodium or bicarbonate. It is more likely the result of accumulation of soil organic matter (thatch) in soil pores. In addition to reducing occluding soil pores, soil organic matter can hold water at the soil surface. This can cause the turfgrass plants to struggle, increase algae growth in voids and trick growers into thinking its some kind of salt problem (Fig. 2).



So, what should we do to increase infiltration rate?

The answer is not to spray some magical “liquid-aeration” product, but to practice regular cultivation. Monthly needle-tine aeration, sand injection, and other forms of venting can improve infiltration. Regular sand topdressing also helps dilute organic matter accumulation and protects turfgrass crowns during summer stress. Application of wetting agents can also help improve soil infiltration when soils are very wet, but they can also help improve water holding as soils approach wilt points.

Figure 2. Calcium carbonate mineral is forming on the top of a layer of algae which is the underlying reason for the reduced infiltration rate of this putting green.

Bill Kreuser, Assistant Professor and Turfgrass Extension Specialist, wkreuser2@unl.edu