Product Information Bulletin

DEALING WITH SALT-AFFECTED SOILS

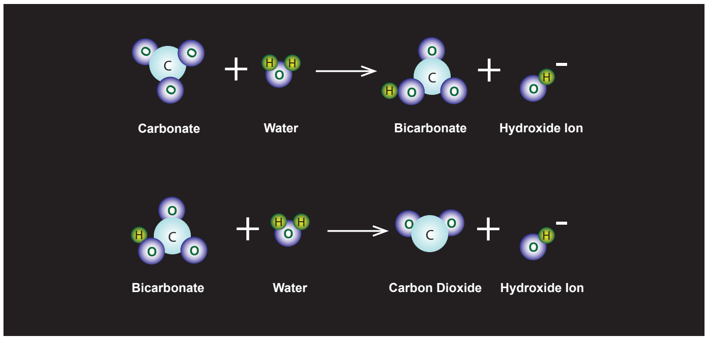
Golf courses rely on irrigation to sustain healthy turfgrass conditions. All water from sources other than precipitation contains some salts. Areas in arid or semi-arid regions are known for their high pH soils – the result of water sources containing significant levels of carbonates and/or sodium. Salt related problems in water used for golf course irrigation is increasing rapidly as regulators are mandating use of reclaimed or effluent water sources on these properties. This situation is made worse when water use restrictions preclude using sufficient water to leach alkaline forming compounds from root zones.

Of all the constituents in irrigation water, carbonates and sodium are recognized as key limiting factors in maintaining high quality turf on golf courses. Dealing with high salt content in irrigation water requires integrated management practices based on routine examination of soil and irrigation water reports taken from various locations on the golf course property. Indeed, salt management practices on coarse-textured soils (quartz or silica) such as found in greens, tees and surrounds, may be quite different that those used on finer textured soils fairways and rough that contain much higher levels of clay.

Alkaline Conditions in Coarse Textured Soils

The most important compounds in water that determine alkalinity include the carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) ions. **High concentrations of carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) in irrigation water create reactions that can significantly raise the pH value through the production of hydroxide (OH^-) ions.** The hydroxide ion is a strong base. An increase in OH^- concentration will cause the pH to increase. Soils with a pH greater than 7.0 (typically 7.5 to 8.5) are generally considered alkaline.

When bicarbonates or carbonates are added to the soil water, exchangeable calcium (free calcium) is pulled from the soil particle surface to form limestone. In this process, the calcium is replaced by hydrogen ions from the soil water resulting in an increase of OH- ions that increases pH.



At pH levels above 7.0, calcium carbonate becomes insoluble. When irrigation water and soil water containing calcium carbonate collect and dry at or near the soil surface, they can form hardened calcareous deposits (usually near the surface) can inhibit penetration of water into the soil as well as cause a disruption in uniform water movement through the soil profile.

In addition to poor water infiltration and water penetration associated with alkaline/calcareous soils, plants are more vulnerable to biotic and abiotic stresses and nutrient availability is disrupted. For example, the availability of phosphorus to plants for uptake and utilization is highly impaired in alkaline and calcareous soil due to the formation of insoluble calcium phosphate minerals.

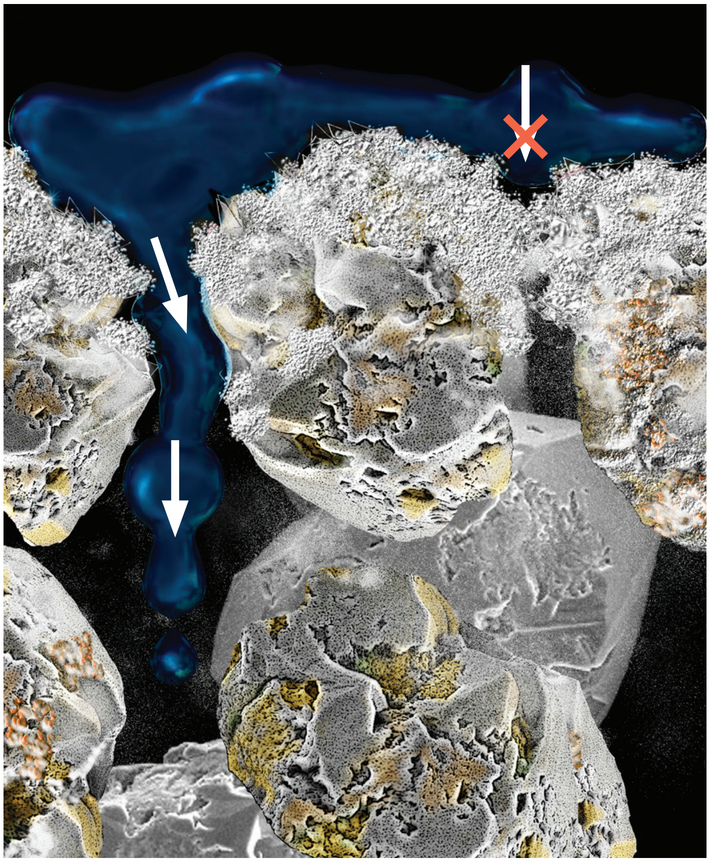


Illustration of sandy soil profile with calcareous deposits. Note unobstructed flow of water through pores on the left versus the blockage of applied water through pores on the right side of the soil profile.

Sodicity in Coarse Textured Soils

Sodicity. Sodicity is a term used to describe the amount of sodium held in a soil. Sodic soils are usually defined as those that have an exchangeable sodium percentage (ESP) of more than 15. Sodic water is high in sodium (Na^+) ion concentration compared to concentrations of calcium (Ca^{2+}) ions and Magnesium (Mg^{2+}) ions.

The sodicity of water is expressed as the Sodium Adsorption Ratio (SAR), and water is deemed sodic if it has a SAR greater than 12. Sodic soils are generally defined as unstable, exhibit poor physical and chemical properties that impair water infiltration, water availability and plant growth. **Definitions of sodic soils however, usually refer to the affect high sodium levels have on clay soils, not sandy soils such as found on greens, tees and surrounds.**

Soil Texture is Often Overlooked. The importance of soil texture when evaluating management programs for sodicity is often overlooked. Soil texture helps determine how much water will be able to pass through the soil and how much sodium can attach to the soil particles.

Sodicity can be a significant problem on clay soils such as found in fairways, push-up greens and roughs. Because clay is composed of small particles that held closely together, drainage of water is often quite slow. Therefore, it is difficult to flush (leach) sodium ions through the soil profile.

As sodium builds and replaces calcium within the clay platelet structure, clay soil will swell excessively when wet. This promotes structural decay of the clay constituents of soil as well as collapse of soil pores that can result in very poor water and air movement through the soil.

Sand-based soils such as found in greens, tees and surrounds have much larger soil particles than clay and therefore, contain larger pore spaces that allow water to pass through much easier than clay soils. Superintendents are able to irrigate and flush dissolved salts from the root zone by leaching.

The surface area on sand particles is much smaller than clay particles, so there is less risk for excess sodium to bind to them and cause dispersion. In clay soils, drainage problems may surface when sodium base saturation exceeds 5%. Constructed sand-based greens, tees and surrounds may not experience drainage problems until the sodium base saturation rises well above 5%.

TREATING SALT-AFFECTED COARSE TEXTURED SOILS WITH pHAcid

Today, many soil scientists recognize that management of alkaline and sodic conditions in coarse textured soils found in greens, tees and surrounds centers on tactics that 1) reduce the pH of the soil, 2) remove calcareous build-up that inhibits effective leaching strategies to be initiated and 3) solubilize Ca and Mg carbonate – allowing these cations to displace Na from the soil CEC.

pHAcid
SPRAYABLE SOIL WATER ACIDIFIER

pHAcid is a unique combination of a blend of acidifying agents combined with a multi-purpose, high molecular weight surfactant. This combination of complementary technologies is designed to be applied in a tank spray to provide the superintendent with a proactive approach to:

- Neutralize the negative effects of high bicarbonate and carbonate levels in irrigation water and the soil solution
- Lower pH of irrigation water and soil water
- Maintain the solubility of Ca and Mg in irrigation and soil water
- Dissolve calcium carbonate and magnesium carbonate salts on the surface (crusts) and in the soil profile
- Improve the ability of soil-applied Ca-based amendments to produce soluble Ca
- Flocculate dispersed colloidal-sized clay particles

High Ca/Mg, High HCO_3/CO_3. When high levels of calcium, magnesium, carbonates and bicarbonates are present in irrigation water and problems with high pH and/or infiltration rates are noted, acidification of the problem area with pHAcid Sprayable is recommended to neutralize the pH condition as well as to improve infiltration of applied or rain even water by solubilizing calcite deposits.

High to moderate Na, High HCO_3/CO_3. If high levels of sodium (Na^+) are present in conjunction with high levels of carbonates and bicarbonates, acidification with pHAcid Sprayable is recommended to 1) release calcium from calcium carbonate deposits so "freed" sources of Ca can be used to displace Na from the soil C.E.C. and 2) remove excess CO_3^{2-} and HCO_3^-, so that Ca^{2+} and Mg^{2+} in the irrigation water and calcium applied amendments are allowed to remain soluble (rather than precipitated as lime) to displace Na from the soil C.E.C.

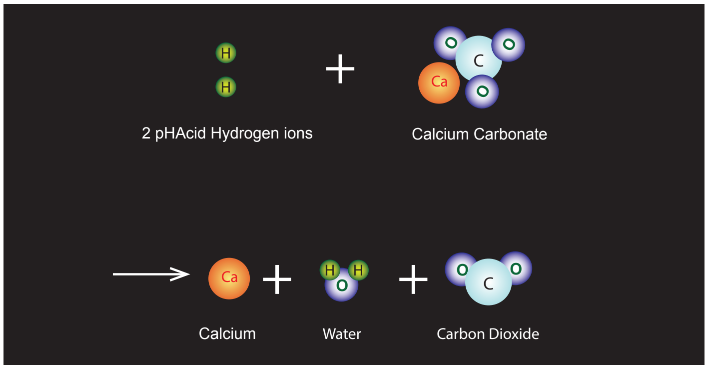


Illustration of acidification of calcium carbonate forming "free" calcium (exchangeable), water and carbon dioxide.

Acidification of identified problem areas also promotes precipitation of Na salts from the root zone.

pHAcid SURFACTANT

The non-ionic, "block" surfactant used in pHAcid was chosen specifically for its ability to enhance infiltration, percolation and drainage characteristics of the soil profile. This facilitates the coverage of the pHAcid treatment as well as enhances the "leaching" of sodium and carbonate salts from the rootzone.

This unique surfactant has also been placed into the pHAcid formulation due to its ability to form an interconnected structural pattern that encourages dispersed clay platelets and organic matter to merge and initiate reformation of clay aggregates.

As the clay platelets are drawn together, calcium cations are electrostatically attracted to their surfaces and replace the sodium cations. This forms the basis for a stronger and longer lasting aggregate assembly.

USE DIRECTIONS

We strongly recommend that water and soil samples be taken and analyzed on a routine basis in order to develop and maintain a comprehensive management plan to correct sodium-affected soils.

pHAcid Sprayable application program: 32 to 64 ounces per acre in a 1 to 2 gallon spray solution per 1000 sq. ft. Apply sufficient water to move product into the soil profile.

pHAcid treatments (in combination with soluble sources of calcium if needed) should be continued until calcareous deposits and water movement problems have been addressed and sodium-affected soil levels are below hazardous levels (base saturation <5.0).

A good seasonal and annual monitoring program is recommended.

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