

# Flushing Greens: More Than Just Heavy Watering

Flushing salts from the soil profile is a necessary, manageable, and productive procedure when correct techniques are utilized.

BY BUD WHITE

**F**lushing greens is certainly not a new concept for golf courses, as many superintendents over the years have used this technique to remove salts from the soil. This practice is particularly common where salt-laden irrigation water is used and in areas along the East Coast, Gulf Coast, California coast, and Desert Southwest. However, there are a surprising number of golf facilities that heavily water their greens in a misdirected attempt at flushing, which does not achieve the intended goal and can actually exacerbate salinity problems. This article outlines the following five-step program to effectively flush greens to reduce soil salinity:

1. Soil and water testing
2. Venting or aeration of the soil
3. Applying gypsum, wetting agents, and/or soil amendments
4. Flushing
5. Replenishment of nutrients

This is a specific program that requires more than just saturating the greens with water. All steps must be carried out as thoroughly as possible for the most efficient and effective flushing results.

## SOIL AND WATER TESTING

Detailed water and soil tests are necessary to determine whether a flushing operation is needed. The results will determine the level of salts in the irrigation water and soil. If salt is a problem, regular monitoring — about three to four times per year — should be performed on a continued basis. The testing should include an electrical conductivity of soil extract (ECe) test to determine soluble salts and sodium in the soil and an irrigation suitability test to determine the quality of irrigation



*Salt damage is often more severe on trees and ornamentals because they have less salt tolerance than many turfgrasses.*



*Flushing requires a considerable amount of water to be effective. Quite often, 1.25 to 2 hours of irrigation are needed.*

water. Regular irrigation suitability tests will quickly show any trends and changes of salt levels in irrigation water. The most common example of fluctuating irrigation water quality is salt accumulation that can occur as water evaporates during drought

periods. If fluctuations in water quality occur, flushing and applications of soil amendments to reduce salinity should be scheduled accordingly. Furthermore, it is important to use a handheld, portable salinity meter on a weekly schedule to track changes in

soil salinity and help determine when flushing is necessary.

## VENTING OR AERATION OF THE SOIL

The timing and frequency of flushing depend on course conditions, water quality, and the infiltration rate of the

face tension of the soil and increase the ability of water to quickly move downward through the soil profile. This can easily be done on greens with small solid tines (often referred to as pencil or needle tines) to impart minimal disruption to the putting surface. Slicing can be carried out on



*Aeration or venting that penetrates through organic layer(s) in the soil can help break soil surface tension and is necessary to achieve the greatest results when flushing.*

soil. Leaching cannot occur without adequate water infiltration. Thus, flushing salts is much easier in high-sand greens or at sand-capped golf courses than areas with fine-textured, heavier soils. It is not uncommon for golf facilities using irrigation water with high concentrations of dissolved salts to flush soils every two to four weeks during the growing season. In many instances flushing is still necessary during the early spring, late fall, and winter; however, flushing frequency is often reduced during these times because weather conditions are not as taxing and plant uptake of salts in the soil solution is not as high.

To help improve infiltration rate and flushing, venting or aerating prior to leaching is necessary. Methods of venting or aerating help break the sur-

tees, fairways, and immediate roughs for the same reason. It would be ideal to always combine core aeration with flushing, for obvious reasons; however, core aeration is not feasible on the frequency that many flushing programs require. Therefore, core aeration usually only accompanies flushing once or twice annually.

## APPLYING GYPSUM, WETTING AGENTS, AND/OR SOIL AMENDMENTS

Gypsum, wetting agents, and/or soil amendments are typically applied prior to flushing events. Where high levels of sodium are a concern, testing laboratories can recommend rates of gypsum based on soil tests, climate, and soil texture. It is not uncommon to apply 10

to 12 pounds of greens-grade gypsum per 1,000 square feet on putting greens when accompanied by core aeration or 7 to 8 pounds per 1,000 square feet when venting is done prior to flushing. Moreover, it is not uncommon for soil laboratories to recommend a gypsum application of 500 to 700 pounds per acre on fairways and roughs prior to flushing.

There are many different products on the market claiming to remove salts and sodium from soil, but soil scientists agree that, pound for pound, gypsum is the best material for breaking up salt accumulations, especially sodium, and moving them out of the root system with effective flushing procedures.

If sodium levels are not a concern, the application of soil surfactants or wetting agents prior to flushing can improve water infiltration and assist in removing soluble salts from the rootzone.

## FLUSHING

Remember, flushing is not just heavy watering. A common pitfall is not applying enough water to fill the soil and flush soluble salts beyond the rootzone. Typically, six inches of applied water is necessary to reduce soil salinity by 50 percent. For most golf course irrigation systems with an application rate of 0.8 inches per hour, a 7.5-hour irrigation cycle would be required to apply enough water for successful flushing (Stowell, 2009). Flushing a green constructed using the USGA Method requires filling the rootzone beyond field capacity to release the perched water table. Following the release of the perched water table, the soil profile quickly drains back to below field capacity. As the release of water occurs, water moves through the profile at such a high rate that air is drawn into the profile. Therefore, as ironic as this seems, a flushing operation actually increases soil aeration. This is why it is not uncommon that some greens may exhibit a greater amount of localized dry spots the day after flushing. However, soil moisture quickly stabilizes after one or two days. This condition is worse with straight-sand greens because the rootzone has less ability to hold moisture than when an organic



or inorganic amendment is used in the rootzone mix.

Managing bentgrass flushing during the summer heat is critically important, especially when watering is such a delicate balance. However, venting prior to flushing improves the infiltration of heavy water applications and helps prevent prolonged surface saturation, which can cause wilting, algae, and disease problems. Remember, flushing a green constructed using the USGA Method will actually dry the upper portions of the soil following flushing.

When soil conditions do not allow for heavy application rates of water because of reduced infiltration rates, pulse irrigation is often used. Pulse irrigation is a series of short-run irrigation cycles that matches application rate with infiltration rate. Flushing may need to be carried out over a 24- to 36-hour period using pulse irrigation.

Superintendents sometimes question how to flush when they do not have dual-system irrigation systems around greens. With a dual-system irrigation design, one set of heads irrigates only the putting surface and another set of heads irrigates only the green surrounds. This makes flushing greens fairly straightforward. In the

absence of a dual-system design, when irrigation heads irrigate both the putting surface and green surrounds equally, superintendents cannot flush the greens without also flooding the green surrounds and greenside bunkers. However, flushing has been in practice long before dual irrigation systems around greens were developed. Many superintendents, prior to dual irrigation systems, used set sprinklers or roller bases placed in the center of each green to flush soils. This allowed greens to be watered all night long and provided a great flushing operation without excess water being applied to green surrounds or bunkers. Although not ideal, this is still a feasible operation where necessary. Another approach is using a portable, low-precipitation-rate irrigation system on the green to accomplish the same goal. Portable, low-precipitation-rate irrigation systems are more efficient than roller bases and are utilized quite extensively with little cost to build.

### REPLENISHMENT OF NUTRIENTS

After a flushing operation is complete, a potassium application is important to reestablish this nutrient on soil-cation

exchange sites as quickly as possible. When sodium removal is accomplished, potassium may also be stripped from the soil, or it was low to begin with as soil-cation exchange sites were filled with sodium instead of potassium. Thus, an application of potassium somewhat serves as a “preventative step” by reestablishing potassium on soil-cation exchange sites before sodium in the irrigation water is reapplied in great quantity. As other nutrients may have been lost during the flushing cycle, this is also a good time to reapply any scheduled fertilizer programs you may utilize to manage putting green nutrition.

### CONCLUSION

With all this water use, is flushing environmentally irresponsible? I firmly believe it is not. The goal of flushing is to move naturally occurring salts below the rootzone where they do not affect turf growth and are not susceptible to capillary movement back into the rootzone. The logical tendency is to think that reducing the application of high-salt irrigation water will reduce salt accumulation in the soil. However, when using recycled water or any other water source high in salts, about



*Portable salt meters are excellent tools for quickly and easily monitoring salt levels throughout the soil profile.*





*Applying low-volume irrigation to only the putting surface has been a proven flushing method for years.*

20 percent more water is necessary to help prevent salt accumulation in the rootzone (Gross, 2008). The increased application rate of poor-quality water keeps dissolved salts moving deeper into soil profile, where they are less likely to re-enter the rootzone through capillary movement. Reducing the amount of irrigation allows salts to move back into the rootzone through capillary action, thus accelerating rootzone salt accumulation. Furthermore, moving salts below the rootzone improves turf health by promoting a healthier root system that can extract nutrients from the soil more efficiently. This reduces nutrient loss into the underlying groundwater during heavy rain events. Fortunately, turfgrasses are relatively tolerant of poor-quality water, which allows recycled water to be used for irrigation instead of potable water. However, recycled water often contains dissolved salts that can become problematic without proper monitoring and flushing programs.

Hopefully this overview has given some helpful insight into proper flushing procedures to ensure the greatest success when reducing salts in the soil profile. Again, flushing is a program and not just a water application. When the overall plan is considered and all steps executed, flushing is effective in managing salts in the soil.

#### LITERATURE CITED

Gross, P. 2008. [Guide for using recycled water: An outline of the costs and maintenance practices necessary to manage this valuable resource](#). USGA Green Section Record. March/April. 46(2): p. Cover, 1-8. (TGIF Record Number **133495**)

Stowell, L. 2009. Leaching calculations. PACE Turf Information Center ([www.paceturf.org/](http://www.paceturf.org/))

#### OTHER USEFUL RESOURCES

[Best management practices for salt-affected golf courses: Why and how?](#)

#### [Leaching for Salinity Management on Turfgrass Sites](#)

Harivandi, Ali. 2013. Using recycled water. New Zealand Turf Management Journal, Summer. 30(4): p. 14-17.

Carrow, R. N.; Stowell, L.; Gelernter, W.; Davis, S.; Duncan, R. R.; Skorulski, J. 2003. Clarifying soil testing: I. Saturated paste and dilute extracts. Golf Course Management. September. 71(9): p. 81-85.

Wastewater Reuse for Golf Course Irrigation. United States Golf Association. 1994. Ann Arbor: Lewis Publishers. 294, vii pp.

#### ACKNOWLEDGEMENT

*The author would like to thank to Patrick Gross and John Foy for photo contributions.*

**BUD WHITE** is director in the Mid-Continent Region of the USGA Green Section.