GEOFLOW
SUBSURFACE DRIP SYSTEMS

MANAGING TURF WITH EFFLUENT WATER

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Effluent water is rapidly becoming a "valuable resource" for turfgrass managers. It plays an important role in water conservation and makes good environmental sense. This article is intended to provide the turfgrass manager with basic aspects of water quality as it relates to effluent water use, and some cultural management adjustments that should be considered.

Effluent water is available for use after proper treatment. Different classes of effluent exist. These include primary, secondary, and tertiary treatment. It is extremely rare to have primary effluent available for direct application use. Raw effluent is 99.8 percent water, and 0.2 percent solids. The more commonly used effluent waters are secondary (second stage treatment) and tertiary (third stage treated) effluent.

Some general characteristics of effluent water are listed below:

Primary - contains no more than 50 percent of the original solids

- no large debris
- can have a bad odor
- can contain pathogens
- not to be used for turf irrigation

Secondary

- slight odor
- more than 90 percent of solids removed
- coliform bacteria count of less than 23
- can be used to irrigate turf

Tertiary

- coliform bacteria less than 2.2
- no or low odor
- highly purified
- can be used for turf irrigation and other purposes

Evaluation of Salt Content

Salts in the irrigation water can be stressful to turfgrass plants. Salt stress is similar to drought stress in appearance, but in this case, the soil can still be moist. Salt levels are measured in terms of milligrams per liter (mg/l), which is identical to parts per million (ppm). The higher the test value, the higher the salt content of the effluent water.

Salt levels are also expressed in terms of total dissolved solids (deci-siemens per meter [dS/m] or millimhos per centimeter [mmhos/cm). Listed below is the general salinity hazard classification which is used to interpret most water quality test reports.

There are several choices you can make regarding irrigation when evaluating salt content of the effluent water. Provide extra irrigation (which is necessary to leach away salts), select a turfgrass which has adequate salt tolerance, or blend water together.

Since salts accumulate in the soil, turfgrass tolerance to salt is often expressed in terms of soil salt levels. The soil in irrigated turfs is usually two to five times saltier than the water with which it is irrigated. Listed on page 16 is the estimated salt tolerance, based on soil salts from a separate soils test.

Establish Good Drainage

In any situation if the soil does not drain well a potential salinity problem may exist. An excellent first step in dealing with saline soil is to establish good drainage. This may include aerification to reduce soil compaction and improve percolation, deep tine cultivation to break up layers in soil that impede water movement, or the installation of drainage systems.

The amount of salt in ***both*** the effluent water and the soil are used to calculate a leaching fraction. The leaching fraction is necessary to prevent soil salt buildup from becoming excessive, which will negate the salt tolerance of the selected turf. Some lab reports provide an interpretive value for the leaching fraction (LF) value. It is calculated as follows using values of dSm-1.

$$LF = \frac{(EC)\ \text{water} \times 100}{(EC)\ \text{soil}}$$

(EC) water = EC from water test for effluent water.

(EC) soil = EC from soil salt tolerance table.

For example, if the effluent water has an (EC) water of 1.5 dSm-1, and the grass is perennial ryegrass which is growing in a soil which has an current soil EC of 6 dS/m. (Note that the maximum soil EC for ryegrass [from the table] is 8.0 dS/m).

The percent LF is as follows:

$$\%\ LF = \frac{(1.5\ dSm^{\wedge -1})}{(6.0\ dSm')}$$

LF = 0.25

The leaching fraction (LF) is used to adjust the actual amount of water applied to meet the ET or water use of the turf ***and*** prevent the buildup of salts in the soil.

Using the same example above, we want to water our perennial ryegrass turf with 0.35 inches of water (to meet the grass ET water use requirement). How much actual water will we need to maintain adequate leaching given the LF of 0.25?

Actual water = <u>ET of grass</u>

(1 - LR value)

$$AW = \frac{0.35 \text{ inches}}{(1-0.25)}$$

$$AW = \frac{0.35}{0.75} = 0.46 \text{ inches}$$

AW = 0.46 inches

Therefore, 0.46 inches of water are needed to irrigate perennial ryegrass with a 0.25 LF value, to prevent an unsuitable salt buildup and meet the turf water use of 0.35 inches.

Another option is to blend water sources to dilute the more salty water source. The salt content of the blended water is easily calculated by multiplying the percent contribution of each water source by its own individual salt content. Two water sources for example are as follows:

Source 1 = 1.5 dSm-1

Source 2 = 3.5 dSm-1

We want to mix three parts of water Source 1 with one part of water Source 2 (which is the same as a 75 percent/25 percent blend). The equation to use is [EC (water) of source 1] x [percent of blend by volume] + [EC (water) of source 2] x [percent of blend by volume] = (1.5 x 0.75) + (3.5 x 0.25) = (1.125) + (0.875) = 2.0 dS/m.

By mixing 25 percent of the more saline water (Source 2) with 75 percent of the less saline water (Source 1), we now have a "blended" supply which will have a salt concentration of 2.0 dSm-1 (or 1280 ppm).

The last consideration is to promote adequate soil drainage. Aerify frequently and deeply. It is impractical to topdress heavy soils on large turf areas with sand following standard two- to three-inch deep aerifications. Rather, use equipment that will provide the deepest penetration possible. Sand topdressing on top of soil will not solve a poor drainage problem. Without proper and enhanced drainage, turfgrass performance will suffer dramatically, or fail altogether

SALINITY HAZARD CLASSIFICATION OF IRRIGATION WATER		
Hazard	ppm or mg/l	ds/m or mmhos/cm
Low	500	0.75
Medium	500 to 1000	0.75 to 1.5
High	1000 to 2000	1.5 to 3.0
Very High	over 2000	over 3.0

Sodium, the Bad Guy

Sodium salts are undesirable as they can prevent desirable soil aggregation. Sodium levels in ppm are listed on a water quality test, along with the Sodium Absorption Ration (SAR). The SAR value is the ratio of sodium to calcium and magnesium (the good guys) and it is almost always part of the test results. The SAR is expressed in values of milliequivalent per liter (meq/l) and not in ppm, or dSm-1. The higher the value, the greater the sodium hazard of the water.

Some water test interpretations include a "gypsum requirement" along with the SAR value. This estimates the amount of gypsum needed to continuously displace the eventual sodium buildup that will occur from the use of the particular water source that was tested. The calcium in the gypsum replaces the sodium in the soil, and the displaced sodium is then leached away.

Nutrient Level of Effluent Water

The dissolved mineral salts in effluent are actually free fertilizer. Here's how to calculate how much free fertilizer you are getting from the effluent water.

From the water quality test report, find out the concentration of the element in question. It should be listed in ppm or mg/l.

Multiply the number of ppm or mg/l by 2.7. This gives the pounds of nutrient per acre-foot of water applied. An acre-foot of water is about 325,000 gallons of water

Convert to pounds of nutrients applied per 1000 ft^2 of turf, by dividing by the value in step two above by 43.

For example, a water test indicates nitrogen content of 15 ppm in the effluent. How many pounds of N per 1,000 f are applied to each acre of turf which receives one foot of effluent irrigation water?

1. 15 ppm N x 2.7 = 40.5 lbs. N/A.F.
2. 40.5 lbs. N per acre foot divided by 43 = 0.94 lbs./1000 sq. ft.
3. Therefore, we are applying 0.94 pounds of N on each 1,000 ft^2 of turf, each time you apply 12 inches of accumulated irrigation, to each 1,000 square feet of turf, if your turf area is at least one acre.

If you apply six inches, you would be applying 0.47 pounds N (half as much). If you apply 18 inches, you would be applying 1.41 pounds of N (1-1/2 times as much). Remember, an acre-foot of water is about 325,000 gallons of water, and an acre is about 43,000 square feet. The calculations above for the amount of free nutrients are based on a specific volume of water (acre-foot). If you use less than this volume, you need to adjust accordingly to determine the amount of nutrient the turf is actually receiving. There can be appreciable amounts of nitrogen, phosphorous and some potassium in effluent water. Look at your total irrigation amounts for the year and calculate the amount of free nutrients.

pH and RSC Values

The pH of the effluent water is not really a big concern. It is hard to change the soil pH based on the water pH (with the exception of pure sands). Of much greater concern is the Residual Sodium Carbonate (RSC) value. RSC is a numerical comparison of the amounts of carbonate (Co-3), bicarbonate (HCo-3), versus calcium (Ca++) and Magnesium (Mg++).

RSC is expressed in units of milliequivalent per liter (meq/l). In the case of RSC, the carbonate and bicarbonates can be "bad guys" if their concentration is greater than the calcium and magnesium. Eventually, the carbonate and bicarbonate can form with the calcium and magnesium to form limestone and dolomite. This eliminates the calcium and magnesium from joining with the soil particles (desirable). If all the calcium and magnesium is "consumed" by the bicarbonate and carbonates, then sodium can occupy more soil sites and decrease soil structure.

RSC values of 0 to 1.25 indicate safe irrigation water, with little concern. RSC values of 1.25 to 2.5 are marginal for irrigation, while 2.5 or greater are not suitable for irrigation. When values are greater than 1.5, injection of the proper amounts of acid into the irrigation system can be considered, which changes the bicarbonates and carbonates to carbon dioxide and water, but does not affect the calcium or magnesium.

If the water SAR value is low, then there is really no sodium threat. In this case, a high RSC value would not require acid injection treatment (as there is no sodium condition). This would be true in areas of high rainfall, where sodium is readily leached away. However, in dry climates, this would be a problem.

General Considerations

Other guidelines are observed for use of effluent. Check with your state regulatory agencies for specific requirements. Some general conditions for consideration are:

post notification on all points of entry and exit that effluent is being used for irrigation purposes only;

potable wells, eating and drinking facilities are a fixed distance from irrigation heads or spray patterns;

use effluent-marked or color pipe which denotes effluent;

no aboveground spigots or hose bibs that can be confused with potable water.

provide adequate storage ponds for meeting irrigation system capacity needs.

SAR HAZARD LEVELS FROM A WATER QUALITY TEST		
Hazard	SAR Value	Concern
Low	10 meq/1 or less	Generally safe for all soils
Medium	1 0 to 18 meq/l	OK for sandy, clay, silty soils - may accumulate sodium
High	18 to 26 meq/l	May develop high soil sodium in most soils. Gypsum most likely required.
Very High	over 26 meq/l	Usually not acceptable for irrigation .

SOIL SALINITY TOLERANCE OF COMMONLY USED TURFGRASS Electrical Conductivity (dS/m^{-1} = $mmhos/cm^{-1}$)

Turfgrass	< 4	4-8	8-16	> 16
Cool Season	Kentucky Bluegrass	Tall fescue	Creeping Bentgrass	Alkaligrass
	Colonial bentgrass	Perennial ryegrass	Western wheatgrass	
	Creeping red fescue			
	Meadow fescue			
	Annual bluegrass			
	Rough bluegrass			

Warm Season	Centipedegrass	Bluegrama	Bermudagrass	Seashore paspalum
			Zoysiagrass	
			St. Augustinegrass	

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