Recycled Water For Turfgrass Irrigation

By Jess Evans

The demand for water increases. Potable water is not an unlimited resource and some discretion must be used when considering its use and conservation. One possible means of conserving potable water is the use of effluent or recycled water for irrigating turfgrass.

Golf courses are a prime example of an area in which recycled water can be used successfully. Golf courses require significant amounts of water and because the costs of fresh water is ever increasing, recycled water is a good alternative. Also, golf courses are usually under intense management by a trained professional who closely monitors water quality and irrigation, making it possible to utilize water of lesser quality. Even so, there are still some important factors that must be considered when determining the quality. These include: total salt content, sodicity, toxic ion levels, bicarbonate, and pH (Harivandi, 1994)

Salinity

Reclaimed waters have been found to have salt levels higher than that of fresh water. There is a high negative correlation between the salt concentration in the soil solution and turfgrass growth. The salts inhibit the plant's ability to access water in the soil solution. As the plant takes up water, the concentration of salt in the rhizosphere increases. This increase in the salt concentration reduces the osmotic potential in the rhizosphere and, thus, reduces the water potential relative to the roots.

Salinity is measured by electrical conductivity or total dissolved solids. Electrical conductivity (EC) is measured as resistance with an alternating current bridge (Butler, 1985). Electrical conductivity is usually expressed as either millimoles per centimeter or decisiemens per meter (dS/M).

Irrigation water with ECw of greater than 0.75 dS/m may cause salinity problems, but real caution must be taken when the EC exceeds 3.0 dS/m. Water with electrical conductivity of great than 3.0 dS/m is not recommended for irrigation purposes (Harivandi, 1994).

Although the electrical conductivity of the water is an important factor when evaluating water quality, it is the electrical conductivity of the soil solution that has the greatest impact on plan growth. Soil sal levels below 3 dS/m usually do not inhibit turfgrass growth.

Sodicity

The sodium (Na) concentrations in recycled water is an other important factor that must be considered when using the effluent for turfgrass irrigation. Although Na itself can reach levels that may cause phytotoxicity in plants, it is the indirect effects of Na on soil structure that causes concern (Harivandi, 1994). Hayes et al. (1990) showed that secondary-effluent-irrigated soils contained greater concentrations of potentially hazardous Na and soluble salts when compared to potable-irrigated soils.

The primary effect of Na on soil structure is a reduction in permeability. Sodium causes deflocculation of the soil clay particles. This means that the high sodium concentrations cause an actual physical dispersion of the soil colloids and loss of soil structure. As a result, aeration is reduced, infiltration decreases, and a high degree of mechanical impedance to the root is observed.

The influence of sodium on soil permeability is commonly measured as the sodium adsorption ratio (SAR). SAR is the ratio of the Na ion concentration to that of calcium plus magnesium. Calcium and magnesium help to reduce the negative effect of Na on the soil (Mancino, 1994). Recycled water with SAR values of greater than 9 can cause severe permeability problems when applied to fine textured soils (Harivandi, 1994).

Turfgrass grown in Sandy soils can tolerate a higher SAR than turfgrass grown in clay soils. Coarse sandy soils have very low cation exchange capacities. As a result, the Na tends to leach through the soil profile and the soil structure and integrity is maintained. Many modern golf courses construct that putting greens with a sand base, making it possible to irrigate with water of less than optimal Na concentrations. I must point out that most of these sand base greens also have some organic material mixed in with the soil. This organic material provides additional binding sites for the Na and could potentially become dispersed causing problems in the root zone.

The use of effluent water with high sodium concentrations may make it necessary to apply soil amendments, like gypsum, more frequently in order to prevent possible problems with soil permeability. Frequent aeration is another technique commonly used, especially in clay soils (Hayes et al., 1990).

The adverse effects of Na ions on soil permeability have been shown to be counteracted by the concentration of soluble salts in water (Harivandi, 1994). Therefore, the sodium hazard of irrigation water is evaluated considering both the sodium absorption ratio and the electrical conductivity. Increasing salinity reduces the ability of sodium to deflocculate soil particles (Hayes et al., 1990). This is usually due to the counteracting effects of calcium and magnesium.

Besides sodium, recycled waters contain several other elements that can cause phytotoxicity. These include boron, chloride and many of the heavy metals or trace elements. In some cases the turfgrass itself may not be sensitive to these ions, but many of the trees and shrubs are.

Nutrient Benefits

Effluent water contains many, if not all, of the nutrients necessary for plant growth. The concentration of these nutrients in the water may not fulfill the needs of the plant, but are present nevertheless. Hayes et al, (1990) observed reductions in seedling emergence in areas irrigated with effluent water. They attributed this to high ammonium concentrations and salinity. However, these same areas showed improvement in seedling establishment and growth rate. This was attributed to the increases in nutrient availability with effluent water as compared to potable water (Hayes et al., 1990).

Nitrogen is one of the primary macronutrients essential for plant growth. Nitrogen is also a component of recycled water. These two facts make recycled water an attractive alternative to potable water for irrigation of turfgrass. However, the potential of nitrate leaching through the soil into the ground water causes critics to question its use. Healthy turf has been found to remove 90% of the nitrogen delivered by recycled water, even in the cases resulting in a 41% leaching fraction (Mancino and Pepper, 1994).

In addition to nitrogen, effluent irrigated soils have been found to contain significantly higher levels of phosphorus and potassium when compared to soils irrigated with potable water. While the amount of nitrogen in the effluent water may sometimes be less than that required by the plant, the phosphorus levels often exceed the needs of the plant (Hayes et al., 1990).

The nutrients in effluent water are most effective when used in conjunction with a fertilization schedule. Both the water and the soil on which it is being applied must be periodically tested. This allows the superintendent to make adjustment in irrigation and fertilization practices when necessary (Hayes et al., 1990). ✦