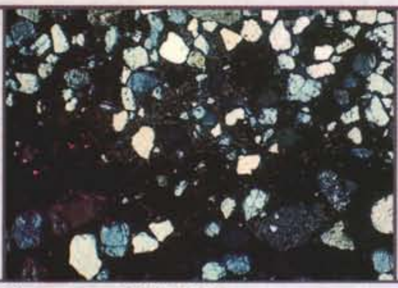

Photo courtesy of: Michael DePew

Sustainable Saltwater Irrigated Sports Field Developments

by Michael DePew and Stewart Bennett, Environmental Turf Solutions, Inc., Pineland, Fla.

Water quality as a component of irrigation management is becoming of greater concern to sports turf managers. Rapid growth in many urban areas has led to a shortage of fresh water resources. This has become a problem not only in the arid and semi-arid western U.S., but many areas in the more humid east also face urban water shortages. Some areas with adequate fresh water resources nevertheless face problems with disposal of effluent water from municipal and industrial waste processing.

Due to either fresh water shortages or effluent disposal needs, the use of effluents and alternative water resources for sports, golf, parks and landscape use has become more commonplace. Brackish water ranging from 2,000 ppm TDS up to seawater concentrations (~35,000 ppm) has been proposed for irrigation. Approximately 97 percent of the earth's water resources are comprised of saltwater. Of the remaining 3 percent comprising fresh water, approximately 2 percent is tied up as ice in the polar regions.

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Saltwater Utilization for Irrigation

New advances in agronomic management technology have made the use of saltwater for irrigation a viable alternative. Principals of Environmental Turf Solutions, Inc. (ETS) embarked on a private research and development program initiated in 1990. This program has led to the development of soil ecology and irrigation management protocols and halophytic (salt-tolerant) turfgrasses. This program has led to improved cultivars of Seashore dropseed (Sporobolus virginicus) and Seashore paspalum (Paspalum vaginatum). 'Saltfine' Seashore dropseed and 'Seaway' Seashore paspalum are cultivars suitable for use in lawns, sportsfields and golf courses. 'Seagreen' Seashore paspalum is a fine-textured turf suitable for use on closely mown putting greens.

With proper management, the use of water with salinities in the range of 10,000-20,000 ppm TDS may become commonplace. The key to the use of high salinity water for irrigation of halophytic turf is the management of the soil to maintain a high redox state (well aerated). Because of this requirement, soil modification is called for on many sites. If the redox potential of the soil becomes too low, many mineral transformations can occur which disrupt the desirable soil ecology. In the process, phytotoxic substances are produced in the soil which causes turf damage and may even lead to turf dieback. One such phytotoxic compound is hydrogen sulfide which is characterized by a "rotten egg" smell.

Traditional salinity management techniques call for shorter intervals between irrigations along with excess applied water as a leaching fraction for salinity control. For sodium control, gypsum (as a calcium source) is often employed as an amendment. While these methodologies can work effectively at lower salinities (<5,000 ppm), at higher salinities these techniques do not apply. Excessive leaching can lead to increased rather than reduced salinity, especially at the surface. This is due to a salt partitioning affect.

The properties of a mixed salt solution in the soil is such that a partitioning of salt ions occurs with leaching. Chlorine (Cl-) and calcium (Ca2+) ions for example are more readily leached than sulfate and sodium (Na+) ions. While Cl- and Ca2+ are readily leached lower in the soil profile, the formation of sodium sulfate is favored near the surface due to its movement as a function of evaporation. While sodium sulfate is a soluble salt, upon precipitation it forms a somewhat impervious crust or layer near the surface. This is due to the characteristic of sodium sulfate to form a salt precipitate with overlapping crystalline edges. This phenomenon reduces the exposed surface area of the salt, thereby reducing its effective solubility and may render a layer somewhat impervious.

A sulfur (S) enriched and impervious layer sodium sulfate is subject to the reduction of sulfur by anaerobic bacteria. The bacteria that reduce the sulfur do so in the process of breaking down organic matter. During this process, Na is liberated and combines with carbonate ions which are released from the breakdown of organic matter to form sodium carbonate. Sodium carbonate at equilibrium in an aqueous solution has a pH of 10. At this pH, fine silicate soil particulates are unstable and begin to go into solution. Subsequent reprecipitation of silicates leads to cementation.

These are just a few of the scenarios that may occur and affect the soil ecology in a saline irrigated soil. The transformation and translocation of minerals in a highly saline soil solution are wide and varied. The physical, chemical and biological processes in the saline soil favor a system that operates in nature in the formation of wetlands (hydromorphic soils). The resulting hydromorphic soils in an athletic field are not ideally suited for high quality production of turf. The key to successfully utilizing saltwater for irrigation is the maintenance of a high soil redox state (well aerated soil). For highly brackish and saline water (5,000 to 20,000 ppm) soil modification may be needed. If >20,000 ppm salinity is called for, a rigidly specified sand-based system is required.

The ETS-developed halophytic turf has been developed in saline environments and have known high salinity tolerances. Other halophytic turf developed or produced in fresh water ecosystems may have unknown or unpredictable performance when placed into a saline environment. In a properly considered saline landscape development, salinity is managed such to maintain a proper (well oxidized) saline soil rather than it being considered a detrimental factor. Figure 2 lists some criteria which may prove helpful for managing a saline ecosystem.

It is impossible to consider all of the factors for developing and maintaining a saltwater irrigated installation in a brief article. It must be emphasized, however, when dealing with advanced salinities (>5,000 ppm), traditional standard techniques for salinity and sodium management at lower salinities must be altered to reduce detrimental effects initiated by salt partitioning. However with proper management, it is possible to develop and sustain saltwater irrigated (>5,000 ppm) installations. ■

Michael DePew and Stewart Bennett are two of the principals of Environmental Turf Solutions, Inc. located in Pineland, Fla. DePew is an agronomist/soil scientist that works with soil ecology issues for ETS. He also serves as chair of the technical standards committee for STMA. Bennett is a Certified Golf Course Superintendent and the head of Golf Operations at Alden Pines Country Club. Alden Pines is where much of the field development work for ETS has been conducted. Contact www.etsturf.com or www.saltgolf.com.

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