Irrigation: It's a matter of control

Irrigation practices are controlled by permits, restrictions, water quality, soil conditions, course design and much more.

BY JOEL D. JACKSON, CGCS

From the cover story on Sailfish Point to the Legislative Updates in the "Official Business" section (see page 90), it is plain to see how important water is to our business. Water issues can be anything from a political time bomb to just a simple question of, "How much irrigation should I run tonight?"

Our ability to irrigate our golf courses is controlled by permits, water management district restrictions, water quality, soil conditions, course design and construction, pumping system capacities, controller capabilities, computer-controlled weather stations, system designs, wind and golfer expectations. Have I left anything out?

Turf research and consumptive use permits have taught us that we should and must learn to live with less water.

Users of higher saline water have begun to use more salt-tolerant grasses or inject diluted acid into their supply lines to modify the pH level of the water. Some courses along the coast are

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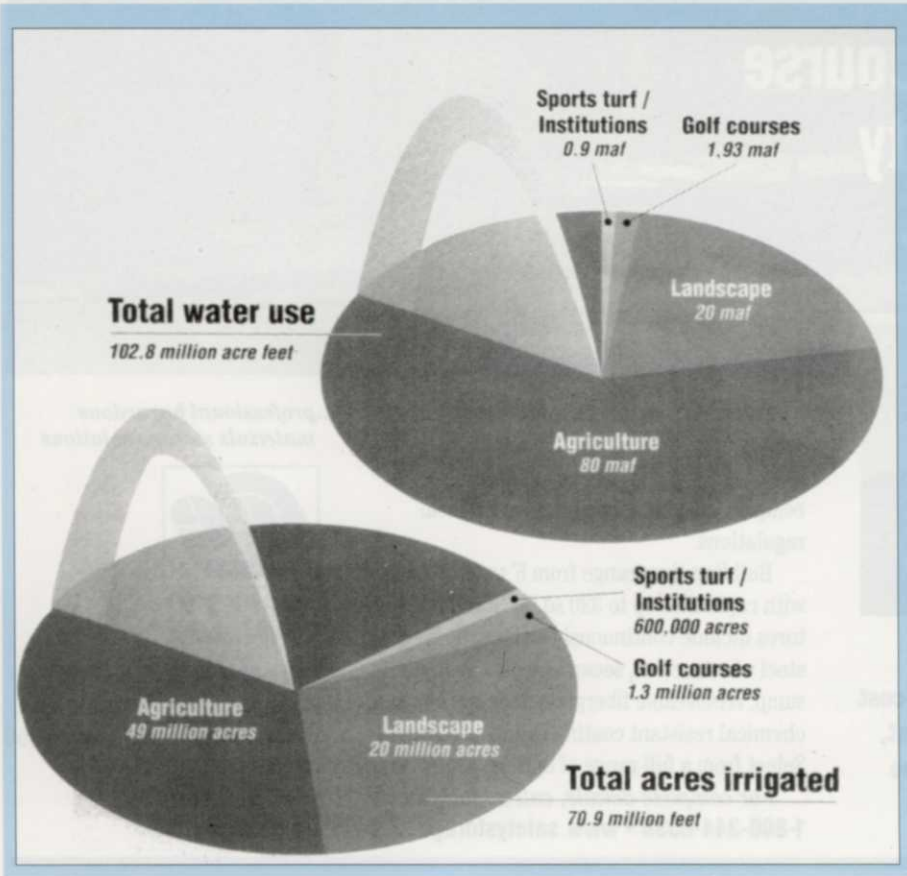
Hot spots by design?

Poor water distribution. Is it lack of head to head coverage or ineffective intermediate nozzle patterns creating the parched donut around the head? Or is it some other factor? There were about a dozen of these "donuts" scattered around the course in the early spring. After renovation and increased rainfall they have disappeared. Photos by Joel Jackson.



Who's actually using all of our water?

"Why do golf courses get to 'waste' so much water?"

That's what some casual observers are wondering out loud when they see an irrigation system at work on fairways, tees or greens. As with many things having to do with managing often scarce resources, people just driving by a golf course have a tendency to jump to conclusions — very often, the wrong ones.

These often well-meaning, but misinformed, citizens could do well to look at their own backyards, and those of their neighbors, before pointing an accusing finger. Residential and commercial (business places, industrial parks and corporate offices) irrigation has expanded more than 30 percent in the last 15 years and, according to the Irrigation Association of America, more than 20 million acres of residential and com

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mercial landscape are irrigated today. Golf courses account for only 1.3 million acres.

And these figures consider just the fairly sophisticated irrigation installations found in residential areas (albeit they may be do-it-yourself systems) and not the friendly neighbor with his lawn sprinkler and garden hose who puts as much water on driveway and sidewalk as he does the lawn.

Since 85 percent of this residential market gets its water from public or private water agencies, the cost of putting water on this property is substantial.

The association estimates that residential and commercial installations about 20 million acre feet of water each year. If an acre foot (325,000 gallons of water) costs $400, the value of the water applied by these systems would be in the neighborhood of $7 billion.

(According to the American Water Works Association, the average cost of public water to residential users is $572 per acre foot.)

By contrast, the golf course industry uses fewer than 2 million acre feet of water each year — less than 10 percent of what's used by homeowners.

And many golf courses draw irrigation water from wells on the property, or ponds and impoundments built just for that purpose. They don't rely on public water sources for irrigation.

Since the first automatic landscape irrigation systems were invented nearly a century ago, residential irrigation has often been considered a luxury rather than a necessity, but that's no longer the case for many people.

Next time a well-intended but short-sighted neighbor questions your "wasting" water, share some of these figures. Billions of dollars can be saved by homeowners and business owners making better use of irrigation technology — the kind of technology golf course superintendents use every day!

Credit: Minnesota Hole Notes.

Matter of control

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already turning to desalinization equipment to manufacture their own fresh water.

Irrigation delivery systems around the state range from a night water man using manual snap valves to radio-controlled, computer-managed systems with automatic remote weather station adjustments. No matter how primitive or sophisticated a system is, it still takes a human to evaluate conditions. A weather station doesn't know you applied a pesticide or a fertilizer that needs additional watering. Only humans know that the back left of No. 14 green will start drying out before anything else 24 hours after that half-inch rain yesterday.

The use of surfactants (wetting agents) to condition the soil is becoming more common. Dedicating more manpower and labor hours to spot-watering localized dry spots is a necessity for the conservation of water resources and the sound management of the surrounding turf. Putting good quality water where

and when it's needed is the key and it's not always an easy thing to do. Some of your fellow superintendents share their irrigation stories on the following pages.

Water Water Everywhere

You can drive by the Grand Cypress golf course during a rain and see sprinklers running. The first reaction of most people would be to think the superintendent wasn't doing a very good job of monitoring his irrigation. They would be wrong.

Tom Alex gets 450,000 gallons of effluent from the Hyatt Regency hotel daily and must dispose of it. He has a system of perimeter heads that he must run daily to dispose of that gray water.

"We had a Varitime II control system originally, but we are upgading to the latest Rain Bird computerized system and that has allowed us to disperse the water even better than before," Tom said. "The Grand Cypress site was once an orange grove so we are fortunate to have good percolation and drainage since we are required to put out the water regardless of rainfall."

The newest of Orange County's golf courses, Orange County National, is being built on land in the western part of the county once used as an effluent spray field. The design calls for large ungrassed waste areas as percolation basins for the necessary disposal of effluent water. The addition of the golf course is a way to make the land double its value to the community by also providing a recreational facility.

All of the Disney golf courses are now on Reedy Creek Improvement District's effluent system. The Palm, Magnolia, Lake Buena Vista and Oak Trail courses have the pipline tied directly into the irrigation system and boost the pressure with pump stations.

At Bonnet Creek, the Osprey Ridge and Eagle Pines courses store the effluent in irrigation storage lakes and pump from them.

The Palm, Magnolia and Oak Trial courses currently have Buckner Legacy controllers and the Osprey, Eagle and LBV courses have Rain Bird Maxi V control systems with the LBV course undergoing an irrigation rehab recently. The 25-year-old block systems at the Palm and Magnolia are scheduled for redesign over the next two years.

While the above-mentioned courses are blessed with unlimited water resources for the immediate future, they are more the exception than the rule. Most golf courses have to ration their ground or surface water based on consumptive use permit limits.

Water resources continue to be a major concern in the legislature as our state continues to grow in population. Be sure and read the Legislative Update section elsewhere in this issue where Mike Goldie and Tom Benefield report on this year's water bills.

Managing My Irrigation, Changing My Water Source

BY SCOTT BELL, GCS
Bent Pine G.C.

Since 1977 Bent Pine Golf Club has irrigated with artesian ground water from the Floridan Aquifer. The water is piped directly from the well into the pump station where the pumps pick up the water and send it out through the system.

I have been irrigating over 120 acres with two 50-horsepower motors on vertical turbine pumps. This system has been very energy-efficient — my electric bills rarely rise over $1,200 per month. Since 1994, the St. Johns River Water Management District has been working with us to change our water source to storm water or effluent.

The club has a close proximity to the North Relief Canal. Years ago we were allowed to divert water that would otherwise go out to the saltwater Indian River to our lake system. This has helped us manage and stabilize our lakes and also be environmentally friendly by keeping extra freshwater out of the Indian River.

This water will soon become our irrigation water. Two years ago we began to plan a new lake to supply and hold irrigation water. This fall we got approval to construct the lake.

St. Johns WMD is trying to get all groundwater users to convert to storm water or effluent. The idea is to save the groundwater for potable uses. The construction of the lake will give Bent Pine Golf Club a large water source for the future.

We teamed up with a local fill contractor to handle the digging and sale of the soil. The lake will be dug by a trackhoe and a dragline to a depth of 12 feet below the groundwater level. The fill is being used around town for general purposes.

When the lake is complete, we'll have a new water source and a new VFD pump station. We are hoping that this will not change our watering practices.

The artesian water was slightly on the salty side but I feel that it was beneficial to the turf. We have 12 bentgrass greens that last throughout the summer. I hope that the change in water will not affect the bentgrass.

We irrigate with a Toro Osmac system that has performed very well for the past seven years.

We recently replaced all of the hydraulic tubing, electric wire and hydraulic supply line. The new pump station will be the final stage in the upgrading of our system.

Winter Pines Irrigation

BY JOE ONDO, CGCS

Winter Pines G. C.

Our irrigation system at Winter Pines has gotten progressively better over the years. We started in 1979 with eight holes automatic electric double-row system, and 10 were hydraulic on greens and tees and quick couplers in the fairways. Starting in 1981, we added automatic irrigation one or two holes at a time. We have Griswold controllers and valves, so we continued with those. We used RainBird 51's and 81's on greens and tees and Thompsons on the fairways.

We did this until the City of Winter Park Treatment Plant expanded and brought effluent water to the middle of our golf course. The city helped pay and install the rest to finish our course.

We usually run one or two heads off one valve. We have added part circle sprinklers over the years along the property line and along our lakes.

We had nowhere to install a holding pond, so our pump station was taken out and capped. The city has supplied us with all the pressure and water we need from about two miles away. We average and pay pumping costs for 150,000 gallons a day, and we don't have to use it when it rains a lot.

The city also has alternate sites to pump to, like cemeteries and baseball, football and soccer fields. We work closely with them and have not been down more than 24 hours since 1985.

We also have four monitoring wells that are checked periodically by the city. Water tests are also done by us once or twice a year. Maintenance of our system is an ongoing process that is done by my irrigation technician and myself.

Syringing cycles are run daily in dry conditions to check rotation and water hot spots.

The RainBird 51 and 81 heads work best for us on greens and tees. We can avoid dragging a hose out to water a localized dry spot by stopping the impact sprinkler where we want.

Having an electric system has been good for us because if a solenoid has a short or gets hit by lightning, the breaker will blow on that station to tell you which one it is.

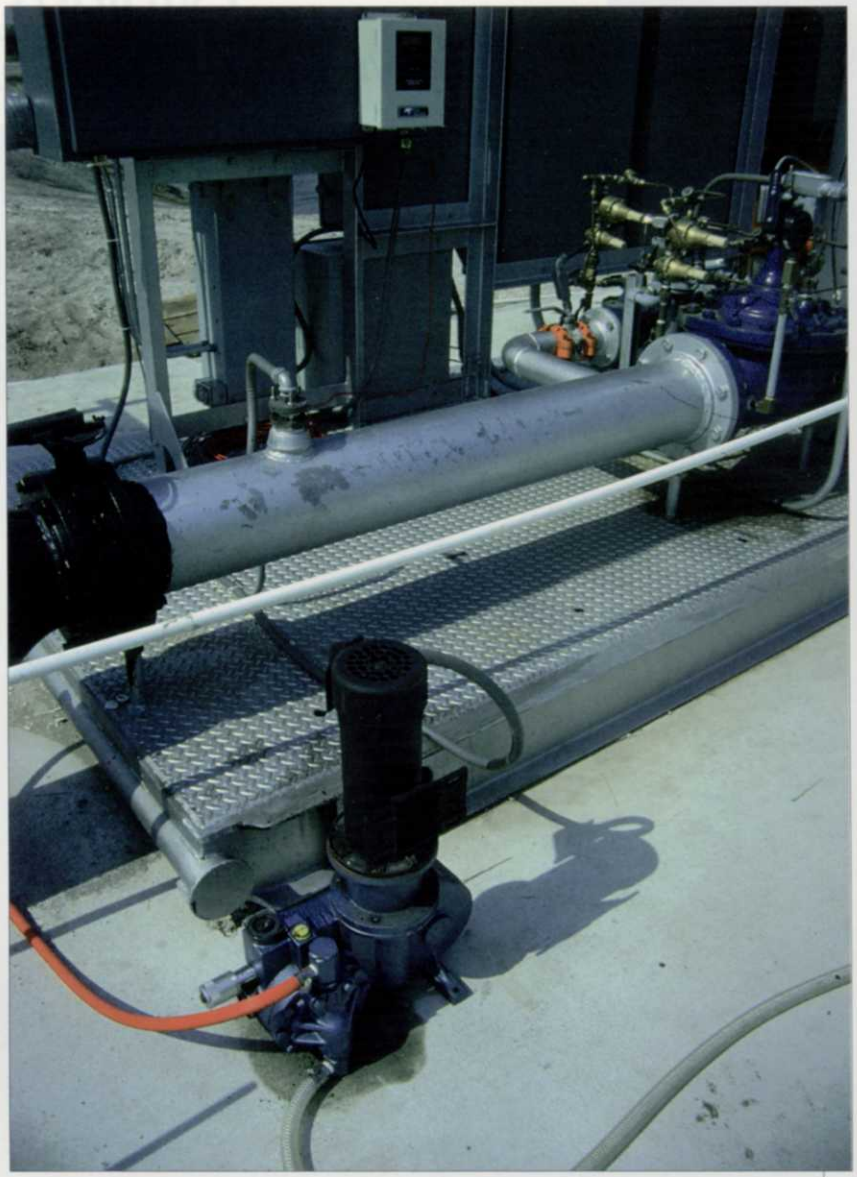
The Griswold valves are self-cleaning and are fairly easy to rebuild. Sometimes a diaphragm will tear or a piece of debris in the valve will cause the sprinkler to run all night, but thankfully those happenings are few and far between. Each station has its own lightning protection so if there is a power surge, the control panel is kept separate and is less likely to receive any damage.

We continue to add irrigation to dry areas as time permits and monitor our coverage as the need arises to change an area. As a whole we have a good system for our course and a good supply of water for the future.

Fertigation:

The legacy of a Florida Success story

BY DR. JOHN L. CISAR,
Associate Professor
University of Florida/IFAS
Ft. Lauderdale Research and Education Center



The liquid fertilizer delivery rate of the pump in the foreground is regulated by the controller in the background to provide a preset ratio of fertilizer to irrigation water regardless of the amount of water being applied. Photo by John Cisar.

In Florida, fertigation systems are almost as common as PCs are in the home, or in a golf course manager's office. Yet not that long ago, both fertigation systems and the PC were relatively new technologies that were not universally adopted or accepted (*Bengeyfield, 1972*). Go back a few more years and these present-day necessities were just someone else's dreams.

Actually, it was nearly 50 years ago that Dr. Roy Bair (1949, 1950), a University of Florida agronomist located at the Everglades Experiment Station in Belle Glade, first discussed the successful use of turfgrass fertigation, the practice of applying fertilizers through the irrigation system.

Thirty years later, Dr. George H. Snyder, professor of Soil and Water Science at the same institution but unaware of Dr. Bair's work, verified fertigation as an agronomically-sound approach to fertilization of turfgrasses (*Snyder and Burt, 1976*).

Dr. Snyder, who worked on turfgrass with Dr. Evert Burt at the Ft. Lauderdale Research and Education Center, was inspired by an aggressive and progressive member of the Boca Raton Yacht and Country Club, John Church, who himself was inspired by the fertigation work being conducted by Ed Darlington and Dr. Max Brown of Liquid Ag Systems in Pompano Beach.

Prior to Dr. Snyder's involvement, no one had conducted turfgrass fertigation studies in a scientific manner that permitted a statistical analysis of the results.

Drs. Snyder and Burt, with the assistance of a high school student, Lloyd Purdy Jr. (now with Duda Sod, Oviedo), developed a turfgrass fertigation facility in Ft. Lauderdale having randomized, replicated, plots and later, having instrumentation for measuring nutrient leaching.

Work conducted at this facility provided a scientific basis for evaluating certain commercial trials by golf courses and fertilizer companies that played a large part in the expansion of golf course fertigation in Florida.

Florida and fertigation a perfect fit

Why was Florida such a good candidate for fertigation?

Frankly, the severe turfgrass growing conditions in Florida are almost ideal for adopting fertigation strategies.

First, in order to obtain the maximum benefit of fertigation (i.e., optimal nutrition from frequently applying small amounts of fertilizer) frequent water application is needed. Our climate provides that opportunity because of the high evaporative demand which requires frequent irrigation to replace evapotranspiration losses.

Second, Florida's sandy soils hold little water, making it necessary to irrigate frequently with an efficient irrigation sys-

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tem that provides uniform water application over the turf area, even during the traditional rainy season.

Third, Florida soils generally are infertile, and have little capacity to retain the many essential fertilizer elements that must be available over an extended period of time.

Poor nutrient retention by rapidly-draining, coarse-textured soils, high Florida turfgrass fertility requirements, high annual precipitation, and shallow potable groundwater resources, all combine to focus concern from the public on the environmental impacts associated with turfgrass management practices.

Fertigation offers the opportunity for superintendents to accurately control the quantity and timing of required fertilizer in an environmentally-responsible manner.

Initial experiments conducted by Snyder et al demonstrated how fertigation could conveniently provide small amounts of inexpensive soluble fertilizer nutrients, such as nitrogen, to maintain high quality turf (*Snyder and Burt, 1976*).

Later tests confirmed the utility of the application method to stabilize turfgrass nutrition by keeping a consistent amount of fertilizer within the relatively shallow turfgrass root system and available for absorption by the grass (*Snyder et al., 1989*).

Finally — and perhaps most importantly — because fertigation permits low rates per application, it has been proven through research to reduce nitrogen leaching better than water soluble fertilizer applied less frequently at higher per-application rates (*Snyder et al., 1977*), providing results similar to those obtained with expensive controlled-release fertilizers (*Snyder et al., 1984*).

Thus, since fertigation provides a practical solution for agronomic, economic, and environmental concerns it is clearly understandable why it is so widely adopted by Florida golf course managers today.

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Fertigation methods

Fertigation is best used to apply fertilizer to turf in frequent, but low per-application rates. Total fertilizer application over time may remain the same as is used for conventional fertilization with dry sources, although many users have reported that lower fertilization rates can be used when fertigation is employed.

The key advantage of fertigation is that the total application of fertilizer can be split up into light, frequent doses of nutrients that can be readily absorbed by the turf without requiring much more labor than is needed for the irrigation itself.

Since the turf is fertilized frequently, growth is consistent over time, and since the per-application rates are low, uptake is rapid, efficient, and there is little unadsorbed nutrient left in the soil solution to leach into the groundwater.

The cost of fertilizers for fertigation should be very competitive with their dry counterparts, and, in fact, should be much lower than controlled-release sources.

The fertilizer can be delivered in liquid form directly to a storage tank, or in some cases via an inlet pipe connection conveniently located near an access road some distance from the storage tank. Liquid fertilizers can be pumped over distances and elevations without the manual effort required for moving dry fertilizers.

Generally fertigation should be used for nutrients that are difficult to manage in the soil, i.e., that are not retained well in the soil. Examples include nitrogen in virtually all soils, potassium in sand soils, and micronutrients such as iron and manganese in calcarious soils.

Nutrients such as calcium, magnesium, and phosphorus are retained well by many soils and can be applied infrequently at relatively high rates. Fertigation is less advantageous in these cases, par-

ticularly if these nutrients lead to a less soluble and stable liquid mix.

Fertigation does not have to be the sole fertilization method.

It often is better to use fertigation to provide a uniform rate of fertilization over a golf course, and then supplement greens, tees, and other high-use areas with foliar, drench, or dry fertilizers, as opposed to attempting to apply varying rates of fertilizer by fertigation differentially over the course.

Additional instructions and suggestions for using fertigation on golf courses have been published elsewhere (*Snyder and Burt, 1974; Snyder and Burt, 1977; Snyder and Burt, 1978; Snyder 1979; Snyder 1987; Snyder, 1994*).

New and innovative uses of fertigation for turf

What about the current research trends and uses for fertigation systems?

Actually, the method of fertigation hasn't changed too much, although the newer injection systems are more sophisticated and often use flow-sensing devices to maintain a constant, though adjustable, concentration of fertilizer in the irrigation water.

But the original concept remains. What has changed is the array of chemicals injected with fertigation systems. Initially designed to inject inexpensive, soluble, inorganic nutrient sources, fertigation now is being considered for application of various soluble organic-based nutrients, organic matter extracts, and biostimulants.

Such studies are under consideration for study at the FLREC.

Fertigation has been adopted for solving other turfgrass agronomic problems as well.

In certain parts of Florida, high calcium carbonate levels in irrigation water from dissolved limestone along with appreciable lime in the soil can result in high-soil-pH-induced micronutrient deficiencies, and in reduced percolation due to precipitated carbonates.

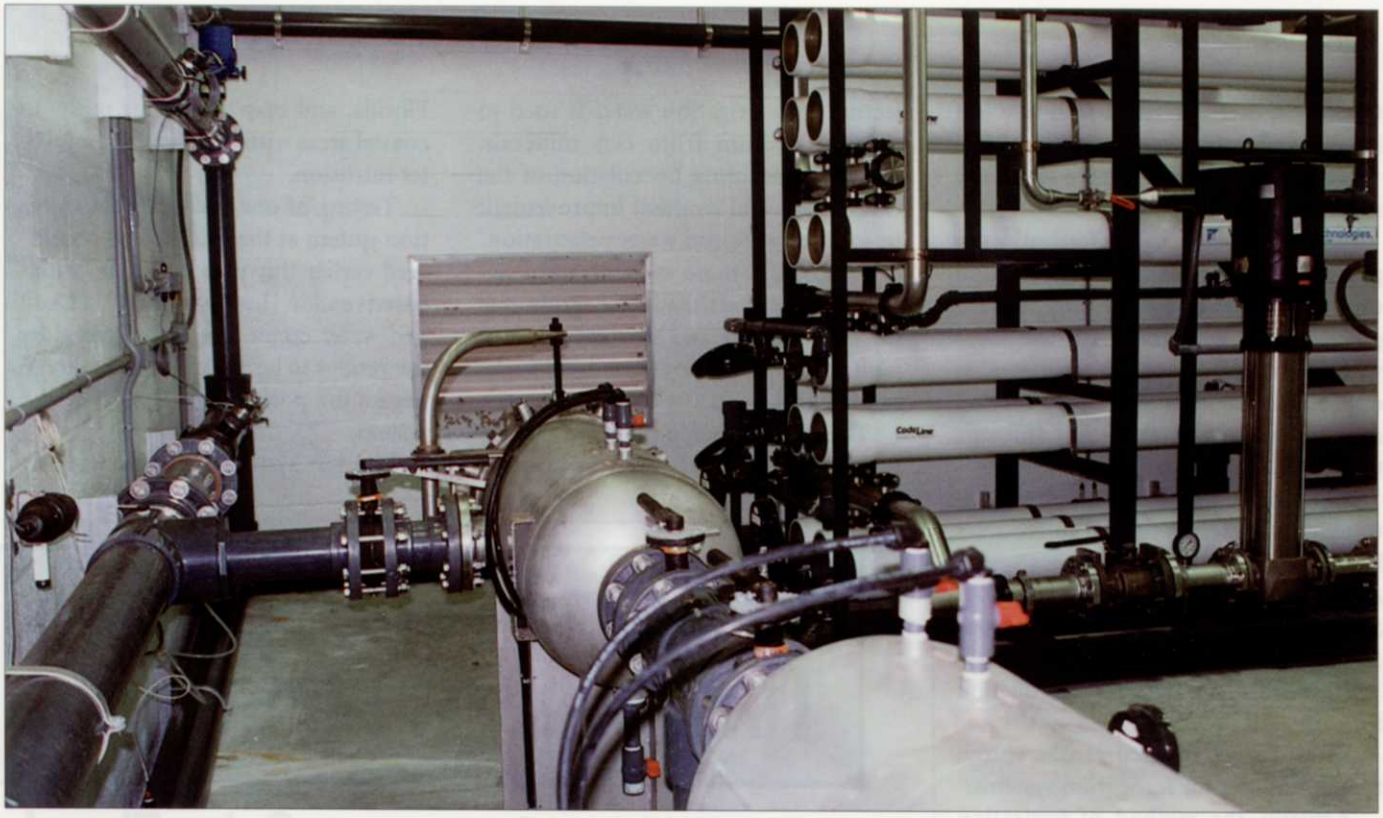
Fertigation systems have been designed to monitor irrigation water pH and automatically inject pH-reducing chemicals into the water to obtain a desired pH. Gypsum (calcium sulfate) injection into irrigation water is used to displace sodium from clay minerals, thereby promoting flocculation of the clays with a concomitant improvement in soil structure and water penetration.

Originally, these systems were designed to combat the adverse agronomic impacts on crops, and now turf grown in high sodium-affected clay soils throughout the arid west.

They now are being marketed to combat sodium-affected turfgrass areas in Florida, and may have some utility in coastal areas with high levels of saltwater intrusion.

Testing of one such gypsum injection system at the FLREC was considered earlier this year by a California-based vendor. However, the FLREC soil and water conditions were judged by the vendor to be of sufficient quality to negate the potential usefulness of the system.

The test system was, however, in-



Make your own water

Since 1996, Peter Brooks at the Everglades Club has been making his own irrigation water from salt water by using a reverse osmosis process. There are two units each capable of producing 300,000 gallons per day. Pete's pump station can deliver 15,000 gpm, but the RO plant can only make 4,100 gpm. So, Pete stores some of his water in a four acre irrigation holding lake. He tries to match flow projections from his Network 8000 to the water needs on the course.

stalled in early 1997 at a golf course in Jupiter, and we await the results of that test.

Conclusion

Fertigation has evolved from a questionable golf course fertilization technique to a commonly-used method of maintaining high-quality turf. Fertigation has been shown to stabilize turfgrass nitrogen nutrition and minimize nitrogen leaching.

Today, fertigation systems are being used to apply chemicals for various purposes other than fertilization. The future may see the use of fertigation systems for applying various organic and biological compounds that assist golf superintendents in providing quality turfgrass.

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