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Compaction

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Compaction Problems

Problems associated with compaction include:

- Bulk density is increased in compacted soils. As bulk density increases, large, non-capillary pores become smaller, capillary pore spaces.
- Although the water-holding capacity of the soil generally increases as compaction increases, water infiltration and percolation are reduced. Decreased water infiltration makes proper irrigation difficult. Standing water on the soil surface and excessive runoff on slopes contribute to inefficient water use. Standing water due to lack of infiltration on compacted soils not only increases water loss due to evaporation, but also enhances turf disease incidence.
- Lack of water percolation on heavy soils creates poor soil drainage.
- Compacted soil may also be drier in summer due to drainage. These soils, being drier than non-compacted soils, generally heat up more rapidly, which cause wilting, drought, and high temperature injuries.
- Compacted soils, having absorbed and held much more water in the winter, warm up more slowly in spring than non-compacted soils. This may be important to areas planted with warm-season grasses, which require high soil temperatures in spring to come-out of dormancy and to green up.
- Oxygen diffusion rate (ODR) in compacted soil is severely reduced. Therefore, oxygen levels in the root zone become limited for root growth and development, since roots need oxygen for respiration. Without respiration, nutrient uptake by the roots is curtailed and turf plants suffer from nutrient deficiencies.
- Water absorption by the roots is also reduced at limited oxygen levels. Since microorganism activity is also reduced because of insufficient oxygen in compacted soils, the availability of nutrients, e.g. nitrogen, sulfur, etc., is also curtailed. This is especially important where slow-release fertilizers (e.g. urea-formaldehyde) are used. Decreased microorganism activity also can result in low thatch decomposition and thus thatch buildup.
- In hardened (tight), compacted soils, root growth may be completely stopped or greatly reduced.
- Turf establishment, whether by seeding or vegetative methods, is hindered.
- Turf wear-tolerance is decreased.
- Turf recuperative potential is reduced.

Symptoms of Compaction

- Turf develops shallow roots.
- Roots are generally thicker and shorter in compacted soils than they are in non-compacted soils.
- Shoot growth is reduced.
- Tiller, rhizome, stolon, and leaf growth is reduced and fewer are developed.

Cultivation practices are damaging to soil structure if done when the soil is too wet, and are ineffective when the soil is too dry.

- Grass stands have lower density and gradually thin out as compaction increases.
- Turf is often invaded by compaction-adapted weeds such as knotweed, annual bluegrass, goosegrass and clover.

Prevention and Correction

- Avoid repeated traffic over the same site.
- Reduce traffic by the use of paths.
- Channel traffic with the use of proper design.
- Use maintenance vehicles with pneumatic tires.
- Change mowing patterns often to reduce the operation of mowers on the same route.
- Increase the height of cut to increase wearability and the root depth where traffic is unavoidable.
- Minimize traffic when soil is wet or near field capacity.
- Develop a soil medium that is relatively resistant to compaction. Sands and loamy sands are least likely to compact, while high silt and clay soils are easily compacted.
- Partial soil modification with physical amendments such as sand, calcined clay, organic matter, etc., may decrease compactability of turf soil. This effect, however, is often short-term and not effective in sites under heavy traffic. Addition of sand to clay soils may actually increase the compactability and destroy the soil structure due to the development of "cementing" conditions. Very little data is available to support any positive effects of chemical amendments such as gypsum in correcting compaction problems.
- Under very heavy traffic and use, complete modification or replacement of soil is the only way to prevent compaction. Examples of complete modification include the University of California, Riverside, pure sand golf green and athletic fields, the PAT™ system, and the USGA Green Section golf greens.
- Incorporate one or more cultivation practices such as coring, grooving, slicing, and spiking into your turf-management program as routine practice when turf is grown on compactible soil. Of these practices, coring is considered the most effective and long-lasting.

Any form of cultivation should be practiced when turfgrass is growing vigorously and can recover from injuries. For cool-season grasses, this period coincides with early to mid-spring and late summer to mid-fall and, for warm-season grasses, the non-dormant season.

Cultivation practices are damaging to soil structure if done when the soil is too wet, and are ineffective when the soil is too dry. Although the frequency of any aerification practice is determined primarily by the magnitude of the traffic and the severity of compaction, agronomically speaking, a heavily trafficked area cannot be over-aerified. (The poorer the soil condition, the more frequently it should be aerified.) Aerification should be avoided, however, during high-temperature periods, when soil is too wet in the winter, and during the period of peak annual weed seed germination.

No single practice is effective in correcting compaction problems. Instead, several must be combined for a successful maintenance program. ❑

Editor's Note: Dr. Ali Harivandi is with the University of California, Riverside, Cooperative Extension. This article was adapted from a session presented on compaction at the University of California, Riverside, during the 1993 Sports Turf Management for Professionals clinic.

Chemical Log:

Organic and Slow-Release Fertilizers

By Helen M. Stone

Faced with demands from turf managers, nurseries, and other green industry professionals, fertilizer manufacturers produce an array of products that accomplish slower delivery of nutrients, particularly nitrogen. Some were developed only recently, while others have been available for years.

Quick-releasing forms of nitrogen, such as urea, can be coated with various substances to allow sustained release as the coating wears off. The "triggers" that cause these fertilizers to release their nitrogen include soil moisture, temperature, microbial activity and particle size. In addition, soil pH can also play a role.

Sulfur-coated urea (SCU) has been an economical source of slow-release nitrogen for several years. The urea, contained by the sulfur coating, escapes through cracks and pores. The breakdown of the coating and release of the urea is accelerated by microbial activity. In addition, the varied sizes of the particles cause some to release more quickly than others.

Resin-coated fertilizers are also a popular option. Water vapor penetrates the coating and dissolves the nutrients inside. The fertilizer is then slowly diffused through the coating. The products rely on soil temperature as a release mechanism. The warmer the soil, the quicker the release.

The latest coatings are polymer-based. The polymer coating depends mainly on soil moisture as a release mechanism. However, once the diffusion process begins, varying levels of moisture do not affect the speed of release, which is governed by the thickness of the coating. Polymers and sulfur have also been combined to create a "hybrid" coating.

Uncoated, slow-release fertilizers are also available. Ureaformaldehyde (UF) is synthesized by combining urea and formaldehyde. The nitrogen release rate of the new compound depends on both temperature and microbial activity. Isobutylidene diurea (IBDU) is manufactured in a slightly different manner. It depends on soil moisture as a release mechanism. It is relatively unaffected by either microbial activity or temperature. The rate of release is determined by various particle sizes.

Turf managers who favor liquid fertilization also have a slow-release option. Methylene urea (MU), used in liquid formulation, depends on both microbial activity and soil temperature for release.

> There are a wealth of new fertilizer formulations that promise good results with less labor.

Going Organic

Ten years ago, a turf manager who admitted using organic fertilizers was considered eccentric. However, today there are several organic fertilizer formulations on the market, with more and more groundskeepers exploring their possibilities.

"Organic" simply means that the substance contains carbon. Strictly speaking, IBDU and UF are organics, because they also contain carbon. There are even formulations available that combine organic and synthetic fertilizers. Perhaps a more accurate term may be "natural" — that is, these fertilizers are generally derived from animal, plant, or mineral sources, as opposed to a manufacturing process.

Organic fertilizers are derived from a number of sources. Manure of all types, sewage sludge, blood meal, cottonseed meal, granite dust and rock phosphate are a few. Generally, organic fertilizers have a lower nitrogen content than chemical fertilizers. They rely on microbial activity to slowly break down the nitrogen into a nitrate form.

Processed sewage sludge is perhaps the most widely known organic fertilizer. Available for years, it is especially useful in warmer months, when soil temperatures and microbial activity is higher.

If the thought of using a manure-based fertilizer brings strong odors to mind, you may want to think again. Today's formulations of manure-based fertilizers are deodorized and sanitized.

In the past, many turf managers who experimented with organic fertilizers were disappointed. For the most part, organics do not produce fast results. However, it is possible to incorporate organics into an existing fertilization program and achieve good results.

Since organics depend in microbial activity for release, healthy soil is essential. Years of chemical use can reduce the quantity of soil microbes. Many organic fertilizers supply a small quantity of organic matter, which will gradually increase the general soil health and quantity of microbes. In addition, new formulations supply their own microbes (or bacteria) to help them release.

Topdressing with organic material, such as compost, also can increase the soil's organic content to some degree, and thus the amount of microbes it contains. Enzyme formulations and other biologically active products are available to increase the soil's microbial activity. These are primarily liquid formulations. One company even specializes in designing customized "microbial soups" that are injected through irrigation systems.

If it has been a while since you've experimented with your fertilizer program, this might be a good time to start. There are a wealth of new fertilizer formulations that promise good results with less labor. Keep in mind that sometimes the parts add up to something greater than the whole. Additives which correct soil pH, improve distribution of nutrient solutions, or increase microbial activity can make more nutrients available than before. Start small. Try tackling problem turf areas with different formulations. With a little innovation, you could become a more well-rounded sports turf manager. ❑

Editor's Note: Helen Stone is the editor of California Fairways *and* Arbor Age *magazines.*

STMA Profile:
Tony Burnett Keeps the Magic

By Bob Tracinski

In 1962, Washington, D.C.'s RFK Stadium seemed pretty impressive to 17-year-old high school graduate Tony Burnett. He was looking forward to starting his summer job under chief groundskeeper Joe Mooney and learning more about what made the stadium complex tick. At the end of the summer, when Mooney asked him to stay and work a year before going on to college, Burnett knew he had much to learn and jumped at the idea.

Bermudagrass sod brought in on May 15 provided a perfect playing surface for World Cup soccer in late June.

"And I got so caught up in the job and loved it so much that I never left," he enthuses.

When Mooney moved on to the Boston Red Sox in 1970, Burnett was ready to take over his position. "My official title is program director/agronomy," he says. "But I refer to myself as chief groundskeeper. It doesn't make much difference what the title is, the job is the same — you just do what needs to be done. With this multi-purpose facility, my job is to make it all come together."

Burnett's responsibilities extend beyond the playing field to include all of the stadium — Armory complex, 120 acres of turf, trees, shrubs, flower beds, parking lots, and buildings. He oversees a grounds crew of 14 and can "pull from" the cleaning and maintenance crew of 24 when necessary to complete a project.

There's a special "magic" to a professional sports stadium — each has a unique personality and its activities seem to take on lives of their own. That magic comes across to spectators on site, as well as to television audiences. Each venue has its own *image*.

Maintaining that image, making sure the public sees the complex in its uniqueness and ensuring that coaches and athletes have first-rate playing conditions is the driving force behind the efforts of Burnett, as well as sports turf managers nationwide.

Transition Zone Challenges

RFK Memorial Stadium is part of the aura of the nation's capital. Event attendees range from dedicated Redskins fans and Washington, D.C.-area concert buffs, to elected officials, tourists and foreign dignitaries. For many, RFK is the only U.S. professional sports facility they will ever see "up close and personal." This adds a little extra pressure for Burnett and his crew.

"Our turf program here is adapted to our transition zone," says Burnett. "We're a little too far north for the warm-season grasses, and a little too far south for the cool-season grasses. Over the years, we've found a formula that is workable. Still, it is a continuing battle due to the weather conditions. We go with the warm-season bermudagrass [Tifway 419] as a base for its strong root structure, then overseed with a blend of perennial ryegrasses to give late-season color.

"RFK's sand-based, Prescription Athletic Turf [PAT™] system field was installed in 1979," he continues. "We were one of the pioneers of the PAT system. I'd say that they sort of 'went to school' on us. So there were a few quirks that had to be worked out, some 'growing pains' that we went through. Initially, we tried to grow bluegrass, but with winters that can be icy cold — with or without snow — and hot, humid summers that experiment just didn't work. Once we developed the multiple-grass program we're using now, we were able to develop a top-quality field."

Feedback from coaches and players confirms that RFK is indeed "one of the better fields in the league." That's quite a feat, considering the competition found in sunny California and Florida.

The stadium's PAT system features suction pumps for removal of excess water as necessary, as well as underground heating. "We mainly use the heat to keep the ground and turf above freezing," Burnett explains. "When we tried to extend the growing season with the underground heating, we sent mixed signals to the turf. The warm ground and cool air opened the door for invasion by pythium and other fungi. The heat is an emergency tool to keep the turf viable through the ice and snow.

"Basically, we rely on good field-cover management to extend the growing season," he continues. "We've found the vented cover essential with shifting weather conditions. Even the bermudagrass stops growing here around the first of October. Covering nightly to protect the turf from freezes and frost

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Brightstar	6.2
SR 4200	6.1
Saturn	5.8
Manhattan II (E)	5.8
Fiesta II	5.8
Pennant	5.7
Citation II	5.6

Color Ratings	
Stallion Select	7.3
Prelude II	6.8
SR 4200	6.8
Delaware Dwarf	6.7
Manhattan II (E)	6.6
Saturn	6.4
Fiesta II	6.3
Gator	6.2

Summer Density Rating	
Stallion Select	6.9
Saturn	6.7
SR 4200	6.6
Yorktown III	6.4
Palmer II	6.2
Manhattan II (E)	6.2

Leafspot Ratings	
Stallion Select	7.3
Saturn	7.2
Repell I	6.8
Palmer II	6.7
SR 4200	6.7
Manhattan II (E)	6.3
Citation II	6.2

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Profile: Tony Burnett

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keeps the green tissue from going dormant. By late November or early December, the overseeded perennial ryegrass is up enough to take over. I'm most concerned about preserving the solid bermudagrass playing base. With TV coverage a vital part of the economic picture, looking good on camera is very important, too."

Keeping the perennial ryegrass thriving and disease-free takes constant attention from Burnett, especially during the prime fungi cycles of early spring and late fall. Once weather slips into its warmer mode, fertilization and adjusted mowing heights are used to control its growth.

"We're not concerned with phasing out the perennial ryegrass," Burnett reveals. "Washington winters consistently wipe out 70 to 80 percent of the bermudagrass, so we budget for replacing the field with new bermudagrass each year. The old turf is stripped out and replaced with big rolls of freshly harvested sod.

"Next year's field is grown to my specifications a year in advance. The fertilization schedule and maintenance program are set, so I know just what we'll be getting. We've worked with Turf Farms, 200 miles south of here in Virginia, for some time. So when the new field arrives, it's already been mine for a year."

Accomodating the World Cup

Perfecting this system over the years gave Burnett and advantage in preparations for World Cup play. (Games were held at RFK June 19, 20, 28, and 29 and July 2.) He's found that procedures using the big rolls of sod have evolved so that the turf becomes established in approximately two to three weeks. With standard sodding procedures, it takes at least six months for establishment.

Still, getting ready for World Cup did mean pushing things a bit. "We brought in the bermudagrass sod on May 15, which really is too early here," says Burnett. "Normally, we don't work with bermudagrass until we put down the 'new' field sod in July. By the end of the first week in June, the weather was just getting into the right pattern for bermudagrass. We overseeded the World Cup sod with blends of perennial ryegrass last fall, and again this spring, so we could bring it into the stadium with active growth. By June 8, the field was settled in and looking good enough to have supported play."

To accommodate the wider playing surface of soccer, 102,000 square feet of sod were brought in, rather than the 90,000 square feet required for the football field. In many of World Cup venues, outside "turf technicians" were assigned to overseed final field preparations. World Cup officials decided that, after 32 years at RFK, there was no better turf technician for that field than Tony Burnett.

RFK has hosted some soccer play each year since 1968, when professional soccer was first played in the United States. Former professional soccer teams, the Washington Whips and the Washington Diplomats, called the stadium turf home. So Burnett and his crews are accustomed to the needs of soccer fields. Still, gearing up for World Cup offered new challenges.

"The World Cup is different," says Burnett. "Everything is more precise. Football is played on top of the turf surface. Soccer *depends* on the turf surface. The turf field has to be a little bit better, a little more consistent for soccer. It's the consistency of the turf that determines ball roll and playability.

Burnett and members of the turf portion of World Cup's Architectural, Construction, and Turf (ACT) team conferred during the weeks before the games were to begin to fine-tune RFK's turf. "Initially, we mowed at 3/4-inch while the sod was taking hold, then moved down to 5/8-inch for the games," says Burnett. "The ACT team wants the fields at all the venues to be as close to the same as possible, so we've all been making adjustments as we go along."

Add to that the daily media attention that converged on all World Cup venues and continued through the heat of play. "By the end of May, it was getting hectic enough around here that media personnel were screened to make sure that they were authorized to be on the field," says Burnett. "We looked at the pre-game hype very carefully and evaluated potential damage in view of the big picture. It was necessary to prioritize World Cup and media needs. The turf and the media had to co-exist because the point of it all had to be the games and the playability of the field."

Fine-tuned Turfgrass

Burnett has grown turf at RFK for so long, and understands its needs so well, that his regular turf maintenance program could be called fine-tuning. "We 'baby' the turf here, in part because I have a super staff," he says. "They know the grass and really care what happens to it. It matters to them that we maintain healthy, highly playable, good-looking turf.

"For example, we don't have a set fertilization program," he continues. "Instead, we keep fertility about the same all the time, applying approximately a half-pound of nitrogen every two weeks. We vary all applications and watering patterns and intervals to meet the needs of the turf. During the football season, we mow the bermudagrass at 5/8-inch. Then, as the perennial ryegrass comes in, we gradually raise the mowing height to one inch. That is grooming it down pretty close for ryegrass, but with the underlying bermudagrass base, it provides an excellent playing surface."

Calling RFK a multi-use facility is an understatement. Besides World Cup Soccer, and the full schedule of Redskins football games, a few other activities are held at the venue. Two professional baseball exhibition games were held earlier this year. Then, after World Cup play ends, the grounds crew begins preparations for Pink Floyd concerts on July 9 and 10, followed by the Grateful Dead July 16 and 17, Billy Joel and Elton John on July 21, and the Rolling Stones August 1 and 3. The Redskins' first game is August 12, followed by two more, and then Eagles have a concert at RFK in September. Then there's a small matter of two college football games and the entire Redskins season.

Leisure time is not a part of Burnett's vocabulary. He's quick to credit his wife, Velita, for giving him the understanding and support he needs, as well as his two sons, now grown and on their own.

Though he does manage to work in some outside consulting when time permits, Burnett says, "I don't like to give advice unless I have the problem in sight. With turf, you don't really know all the circumstances involved unless you're actually looking at the problem and have access to the history of what's been done. Sports turf management is filled with variables."

Since 1962, Burnett has managed those variables. He has the drive to constantly seek a better way of doing things, the commitment needed to cope with constant change, and the ability to "make it all come together." ❑

Editor's Note: Bob Tracinski is the manager of public relations for the John Deere Company in Raleigh, NC, and public relations chairman of the Sports Turf Managers Association.

Exploring Equipment:

Greens Mowers Make Cut in Majors

What do Dodger Stadium in Los Angeles, CA, and Jack Murphy Stadium in San Diego, CA, have in common, besides being homes to Major League Baseball teams? Both use greens mowers to care for the turf. That's not surprising, given both the high expectations of today's players and fans, and the top-notch cut only greens mowers can provide.

At Dodger Stadium, head groundskeeper Al Meyers uses a Jacobsen Greens King™ IV to maintain the outfield at a cutting height of approximately 7/16-inch. The low height of the cut enables the ball to move quickly through the outfield grass.

If that weren't enough, Meyers also uses Turf Groomer conditioner on the greensmower. He credits the device with controlling thatch and grain in the bermudagrass field. Grain can cause a baseball to move back and forth, or "snake," as it rolls over the turf. Meyers says even a slight back-and-forth movement will affect how a fielder plays the ball.

"If the fielder goes to charge the ball and the ball has a tendency to be a little squirrelly, there's a good chance he'll be a little more tentative," Meyers explains. "If the ball rolls true, the player can be more aggressive."

At San Diego Jack Murphy Stadium, where Steve Wightman is stadium turf manager, a Jacobsen riding greens mower is used. Similar to Dodger Stadium, the height of cut at Jack Murphy has been lowered to increased the speed of the ball.

Three years ago, Padres management wanted a fast infield and a slower outfield, Wightman recalls. In 1992, it was just the opposite; the infield was cut at 9/16-inch, and the outfield was cut at 1/2-inch.

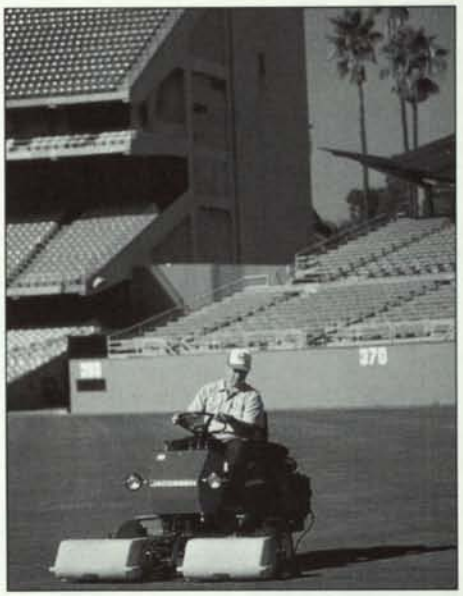
"That doesn't sound like much of a difference, but when you're talking about hybrid bermuda, it makes a world of difference as to how fast the ball goes through," Wightman asserts. "That's because of the tremendous thickness of the canopy. There's an awful lot of leaf blades in 1/16 of an inch. Because all those little leaves act like brakes, they really do slow the ball down."

Using a precision greens mower produces a consistent quality of cut, even at 1/2-inch. Wightman also uses Jake Turf Groomer to get the "snakes" out of Jack Murphy Stadium's turf.

"Each time you mow, you're laying down the blades of grass in the direction you're cutting," Wightman explains. "So you mow one way on one pass, and on the very next pass you're mowing the other way. You're laying the grass in two different directions."

Although Wightman and his crew changed the mowing pattern daily, there was still up to a six-inch "snake" on the ball. When turf groomers were added, the snake disappeared.

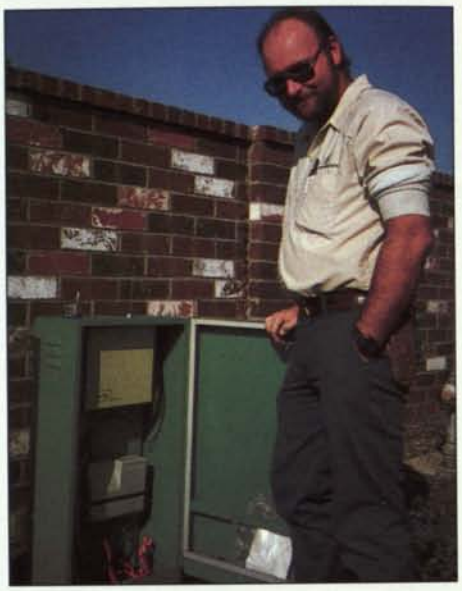
"With the groomers, we've been able to virtually eliminate any snake," says Wightman. "They've been a great help in that respect." ❑



Demands from players and fans for top-quality turf make greens mowers a must at major-league ball parks. Photo courtesy: Jacobsen.

Irrigation Controllers:

SELECTING FOR SUCCESS



Mounting satellite controllers on a wall is usually the least expensive method. Photo courtesy: Milwaukee County Stadium.

By Gaylon Coates

The most important factor in choosing a controller is ease of operation. After all, to be effective in controlling irrigation, the controller must be a useful tool for the maintenance staff. It must be simple to program and schedule, and seasonal changes must be easy to make, without calling the manufacturer each time.

There are basically two major types of controllers available in today's market: electromechanical and solid-state (digital). The electromechanical varieties contain switches, dials, motors, and moving parts to keep the time of day and control operation of the various components. The solid-state digital types are fitted with printed circuit boards, which require no moving parts and therefore cannot "wear out." Digital controllers also afford extremely accurate timing, but are more susceptible to lightning and power surges. When protected against these pitfalls, solid-state controllers are usually the choice today.

The irrigation system designer also must know which kind of valves the controller is going to operate. Again, there are two types: electric- or hydraulic-actuated valves. Generally, the operation of 24-volt electric valves is actuated by providing or suspending electric current to a solenoid fitted on the body of the valve. The hydraulic varieties (either normally open or normally closed) are actuated by supplying a stream of water to or removing it from the valve.

Hand-held remote devices, coupled with computerized controllers, allow field maintenance personnel to energize individual valves without physical access to the controller. Photo courtesy: Hardie Irritrol & Motorola Scorpio.

In selecting a controller, it is also important to know something about the quality and longevity desired by the owner. For instance, there are several brands of controllers, manufactured for the "homeowner," which are inexpensive and basically meant to be replaceable after three to five years. Their quality is such that timing is not accurate enough for commercial projects, and their features are limited. It is crucial that the designer have a working knowledge about at least a few different controller manufacturers' products, so he or she can choose the most cost-effective device for the project. It is also helpful to have firsthand experience with whatever is specified, so you are confident that the piece of equipment you select will provide the control you desire.

Know the Application

There are several criteria to consider regarding the controller application. The first of these is, "How many stations do I need to control?" Today's irrigation controllers (especially solid-state) are manufactured in many configurations of anywhere from four to as many as 52 stations. Many times, these are modular in groups of eight stations, where a new "board" may be added to increase potential capacity. Generally, electromechanical controllers are made