New Construction Method May Reduce Pollutant Runoff

By David M. Casnoff

Within the past 10 years, several pesticide, fertilizer and water restrictions have been placed on turfgrass managers. As a result, many in the industry are looking at alternative construction ideas to help superintendents meet those restrictions without placing an undue burden on them.

My company has devised the Pennfield system, a construction method based on the concepts of reduced water use, increased use of recycled natural resources and reduced pesticide inputs. The company has research in the works and hopes to report the full results soon — but the initial feedback has been potentially promising.

Actions in Maryland resulting from a scare over pesticide and chemical runoff into the Chesapeake Bay sparked my interest in developing such a system. I was also intrigued when Maryland Governor Paris Glendening had some pointed comments directed at the golf course and other turf industries, specifically in the area of environmentally sensitive use of fertilizers on large turfed areas such as golf courses. Understanding that superintendents were doing the best they could with current construction methods, I wondered whether there might be a better way. This was the impetus for study of the Pennfield System.

Strides being made

There is an effort in the irrigation industry to develop new technologies to reduce water use, and many companies have made great strides in this direction. With the onset of drought conditions showing up across much of the United States, this has become a major priority.

In some areas, drip irrigation systems can reduce water use by half. In fact, research done by Bernd Leinauer revealed water use on subsurface-irrigated research plots was shown to be 90 percent to 95 percent less than on sprinkler-irrigated plots.

These subsurface-irrigated plots also had root masses greater at lower depths than those irrigated with conventional sprinkler systems.

If these systems could be used on golf courses, they could make a great contribution to water savings. In addition, use of composted manures and watering systems that can introduce water below the surface and keep the soil surface and turf thatch layers less hydrated could help in the reduction of disease and reduce the use of pesticides. That's why my company decided to build on the existing success of subsurface irrigation systems in the creation of the our new system.

What is the the Pennfield system?

The Pennfield system is a field construction method that uses the concepts set up by the Purr-Wick System developed in 1966. It combines older and newer technology developed in recent years. The components of the system are:

- A pond liner to allow water to be collected from irrigation runs or ambient rainfall. The liner is a low-volume polyethylene product that is lightweight and durable.
- A subsurface irrigation and a subsurface aeration delivery systems (in this case provided by Precision Porous Pipe, a division of Colorite Plastics), including a regenerative blower used to force air through the soil profile.
- A flat pipe drainage system (donated by Advanced Drainage Systems) that is used not only to drain the soil but also as the main component in recycling water resources.
- A micro-injection unit to inject pesticides, fertilizers and soil amendments at precise rates, and a recycling pump unit to help recycle water from collection tanks back to the field or green (donated by Moyer & Sons).
- A soil mixture developed for the Pennfield System which contains 85 percent sand (USGA specifications), 12 percent Canadian sphagnum peat, and 3 percent aerobically composted turkey manure.
- A moisture monitoring and valve control system (provided by Adcon Telemetry) and the software to completely run the guts of the Pennfield system.
- A conventional part of the irrigation system that will be used to supplement the subsurface system during the most stressful times during the year if needed and to help in the cooling process through syringing and the watering-in process for

TABLE 1

Physical characteristics of each of three soil profile/air treatment combinations.

	Sustane with Forced Air	No Sustane with Forced Air	Sustane No Forced Air	Well-Drained Greens – Ideal values
Infiltration Rate (in/hr)	15.96	11.15	6.35	6 to 10
Subsurface Air Capacity (Non Capillary Porosity)	29.07%	26.58%	23.43%	~ 20%
Water Porosity (Capillary)	18.15%	16.53%	20.86%	15% to 20%
Bulk Density (g/cc)	1.31	1.40	1.37	1.40 to 1.50
Water Holding	13.82%	11.83%	15.22%	10% to 15%
Organic Content _ to 1 in.	0.85%	0.42%	0.72%	1.5 to 2.5%
Organic Content 1 to 2 in.	0.72%	0.66%	0.67%	1.0% to 2.0%
Organic Content 2 to 3 in.	0.62%	0.72%	0.77%	0.5to 2.0%
Organic Content 3 to 4 in.	0.75%	0.69%	0.79%	0.5% to 1.5%
Root Mass	_ in.	5/8 in.	_ in.	At least _ in.
Feeder Roots	Medium at 3 in.	Sparse at 3.5 in.	Sparse at 3 in.	At least 3.5 in. – medium density

DATA GENERATED BY THE INTERNATIONAL SPORTS TURF RESEARCH CENTER LOCATED IN OLATHE, KAN.

topically applied fertilizers, pesticides and other chemicals.

Future applications for the Pennfield system are golf greens and tee complexes and high-end sports fields. Parts of the system have been used successfully in park and recreation sports fields as well as high school practice fields.

Potential benefits

The potential benefits of the Pennfield system are being studied as part of a research project being established in collaboration with faculty at Pennsylvania State University. Mike Fidanza at Penn State's Berks Campus is the principal investigator on this project. The intent is to support undergraduate and graduate student education and faculty input, to develop research projects that will investigate environmentally sensitive methods of constructing, and maintaining turfgrass stands for golf courses.

Areas of research will include:

- potential water savings and more efficient use of water resources including gray water;
- reduction of fertilizer inputs;
- possible reduction of amounts and more efficient timing of pesticide applications; and
- reduction of human contact of pesticides with the use of microinjection systems used in conjunction with subsurface water delivery systems.

As the research progresses, other areas of interest will be identified and studied.

Methods and materials for greens

Construction of the Pennfield golf green starts in much the same way as a California green or a USGA green. An experienced excavator will create a subgrade that will mirror the grade of the surface. The depth of the subgrade will be 12 inches throughout the entire profile. Edges of the green should be tapered so as not to have an abrupt transition from the green to the approach.

The piping for the recycling system is installed. Pipes will be connected to collection tanks that gather water from irrigation runs and ambient rainfall.

Once the excavation is done, the low-volume polyethylene liner is installed. This type of liner is easy to work with since it is lightweight and durable. Holes can be cut into this material to accept pipes for irrigation, aeration and drainage. The holes are then sealed using a material specifically made for this process. The irrigation, aeration and drainage systems are constructed on top of the liner.

At this point the air blower is attached to the air delivery system. The air blower that is used is a 2.5 horsepower regenerative blower that has the maximum capacity to deliver

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The small diameter pipes combine the subsurface irrigation and air delivery components of the Pennfield system. The white, flat pipes provide drainage and help recycle water from rainfall and irrigation cycles.

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160 cubic feet of air per minute through the system.

The last pieces of equipment to be installed are the weather station and the water moisture monitoring equipment. These tools are used to help schedule irrigation runs as well as to measure environmental data to help develop the most effective scheduling of fungicides. The software will be used to develop disease models and irrigation schedules. It also controls the valves involved in the subsurface irrigation system, the forced air system and the recycling and micro-injection systems.

It is better to keep everything under one software program to keep things as simple as possible.

Preliminary results and future research opportunities

The first study performed on the green was turfgrass establishment rates for each of the three soil/aeration treatments. Before seeding the plot which contained 85 percent sand and 15 percent Canadian sphagnum peat, a 10-10-10 fertilizer was used to apply .75 pounds N-P-K. Fertilizer was worked into the top 2 inches of the soil profile. No fertilizer was used in the other two treatment areas that had Sustane 2-3-3 in the soil profile.

The green was seeded to five different varieties of creeping bentgrass varieties, including Crenshaw, Cato, Dominant, A4 and G1. The varieties were seeded May 16, 2001, at 1 pound per 1,000 square feet. An 18-24-12 starter fertilizer was used on the 85/15 section of the green at .25 pounds of nitrogen per 1,000 square feet, and was applied the day of seeding and every two weeks for the first 45 days. No supplemental fertilizer was put on other areas of the green that contained the Sustane 2-3-3 in the soil profile.

Several preliminary observations were made for the forced air treatments both for temperature and disease incidence. These two observations are presented as points of interest and will need to be studied in replicated trials to provide evidence that these observations are valid.

The first and most important observation in terms of its implication that the area treated with organic fertilizer did significantly better than the plot that did not, as measured in the number of tillers per plant.

The second major discovery was the major reduction in dollar spot incidence in Crenshaw creeping bentgrass when air is forced through the soil profile.

The results show that the dollar spot incidence is reduced significantly in the forced air treatments as compared to the treatment without forced air.

The plot with no Sustane and forced air through the profile has slightly more dollar spot lesions as compared to the plot with Sustane and forced air through the soil profile.

The other observation was the apparent increase in soil temperature of the soil profiles where air is being forced through them. In Fig. 10, snow is melted from the areas where air is forced through the soil profile. A sharp delineation is seen between plots with air and no air treatments.

Table 1 shows the physical characteristics of each of the three soil profile-air treatment combinations, six months after seeding. Once data has been collected over several years, some greater understanding of these initial observations will be realized. Nonetheless, these initial observations are still quite interesting.

As environmental restrictions continue to evolve throughout the country, we believe the potential benefits of this and other environmentally sensitive construction and maintenance methods will become apparent.

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