

August
2019

Vol. 25, Num. 8

pmengineer.com

pmengineer

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Hitting the green

*Championship
golf course
installs hydronic
conditioning
system.*

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Hitting the green

PGA championship course installs beneficial hydronic conditioning system.



Photos by Dan Frisch Photography.

Above: After carefully prepping the green surface, Creeping Bentgrass is seeded. Right: After the country club voted to install green conditioning systems in 2016, the 300-acre property was closed in early 2018 to permit renovations.

There are golf courses, and then there are elite, world-renowned country clubs. What sets them apart most often: real estate, luxury, aesthetics and playing surface.

The playing surface: it's a point of distinction rarely appreciated outside the exclusive culture of golf. Groomed, nourished, perfected; it's tough to improve so mature an art form. Yet, the managers and groundskeepers at Southern Hills Country Club in Tulsa, Oklahoma, have raised the bar.





Oxygen barrier PERT tubing is laid on 9-inch centers above a 4-inch pea gravel "blanket" at Southern Hills Country Club in Tulsa, Oklahoma.

Founded in 1936, SHCC is a private, member-owned course. It's recognized among the top 100 courses in the world and has been host to 15 major championships since 1946, including the PGA Championship – four times.

To be esteemed as one of the nation's leading courses takes an incredible level of commitment to the game, facilities and player experience. SHCC has dedicated itself to maintaining a prestigious reputation for more than 80 years. One look at its greens tells the whole story.

"It's generally accepted that Creeping Bentgrass provides an unrivalled green surface for championship golf," says **Russ Myers**, SHCC's golf course superintendent. "But it's a cool season grass that requires special care in a southern climate."

SHCC is and has been committed to growing a Bentgrass variety called Pure Distinction on its greens despite Tulsa's hot summers, which can take a toll on playing surfaces. Bentgrass thrives in soil temperatures around 78° F.

"As you'd expect, our worst months are July and August, when we can see soil temps of 90°," Myers continues. "A difference of just five degrees can be a concern. Hot weather, combined with the traffic of sustained golf play, can really stress a green if not meticulously cared for. The only way to improve upon a professional Bentgrass green is to condition it."

True dedication

Over the past 12 years, SHCC has discussed and planned the installation of a hydronic green warming and cooling system across 24 playing surfaces. After being voted on in 2016, the 300-acre property was closed in early 2018 to permit renovations.

The property-wide conditioning system at SHCC would become the first of its kind, capable of operating simultaneously across every green at a golf club. Shortly after the decision was made, **Cary Pestel**, president at manufacturers representative Boone & Boone Sales, called on Myers to discuss planning and design of the system. He knew

that Watts, the rep firm's hydronic tubing product line, had extensive experience with a variety of turf conditioning applications.

"From the beginning, the concept was to run hydronic tubing under the green surface," explains Pestel, whose large rep firm has offices in Tulsa and Oklahoma City. "Cooling was the priority, though having the ability to warm the soil would extend the playing season and permit greens maintenance to take place off peak playing times. The question quickly became, 'How do we provide chilled and warm water?'"

Geothermal was initially considered until it was ruled out due to expense. For a while, a boiler/chiller design was discussed, but the cost of running both gas lines and three-phase power throughout the property, in separate trenches, was prohibitive.

At this point, Pestel contacted Technical Systems, a division of RAE Corp. TSI was well-suited for the project because it builds custom chillers and heat pumps. During an initial site visit, TSI proposed using custom air-to-water heat pumps; one piece of equipment to heat and cool the greens instead of boilers and chillers.

"The biggest logistical consideration Myers had with heat pumps was the need for three-phase power at each of the 24 greens and practice surfaces," says **David Harris**, RAE Corp. account manager. "The challenge was to see if a few large custom heat pumps could serve numerous greens."

Evolving design

Technical Systems and Watts determined the initial load and water temperature calculation based on the greens' required 3.5 tons of cooling per 1,000 square feet. This would allow soil temperatures to be lowered by as much as 15°, maintaining between 65 and 80 degrees throughout the year.

TSI used that information to calculate the heating and cooling capacity needed for each green. Meanwhile, **Kolyn Marshall**, system engineering manager at Watts, worked on the piping design.



Within each Technical Systems' air-to-water heat pump is a pump house, including a variable-speed circulator and heat exchanger. TSI is a division of RAE Corp.

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This allowed new line losses to and from the greens to be calculated.

"You can do just about anything with the right sized heat sink and properly designed piping," Marshall says. "It was more a matter of optimizing upfront cost, efficiency and performance. We looked at the loads and compared options in pipe sizing and general design. For example, larger pipe sizes would have lowered head requirements, but meant higher cost. The location and total number of heat pumps had a bigger impact on supply and return piping to the manifolds, but it still effected the tubing layout design."

TSI's initial proposal was based on a design using six heat pumps to serve the entire golf course; three 100-ton units and three 50-ton units. During subsequent discussions, the number of heat pumps was reduced to four; a 200-, 133-, 123- and 110-ton pump.

"Using as few units as possible was critical to Southern Hills because they didn't want equipment detracting from the golf experience," Harris says. "It also reduced the distance that power needed to be stretched. Once the locations were decided, TSI designed the heat pumps to meet loads."

"The main difference between this project and a 'normal' air-to-water heat pump application was having to pump water such long distances," says **Brett Cobler**, RAE Corp. senior project engineer. "A low-pressure system was needed, but we still had to economically pump hot or cold water through 9,000 linear feet of tubing for any given green."

Piped for performance

From the chiller, golf course irrigation specialists from Formost Construction trenched and installed 2-inch polyethylene supply and return pipe to remote manifolds. Each of the copper Watts manifolds is contained inside an underground manifold box. From here, 3/4-inch Watts RadiantPERT tubing is installed below the sod level. This provides a 35- to 45-gpm flow rate to the green, depending on the size of the green surface.

"PERT was used in place of PEX for two reasons," Marshall says. "Lower cost and greater flexibility. It tends to lay flatter than PEX due to the reduced memory of the material; very helpful considering that the bulk of the Southern Hills project took place over the winter."

In all, SHCC grounds crews laid 200,000 linear feet (almost 38 miles) of oxygen-barrier tubing across 150,000 square feet of treated area. This includes 18 championship greens, practice greens, and a three-hole short-game area.

Greens construction was the most time-consuming part of the project. Only a handful of greens were under construction at any given time. Even without heating or cooling elements, the average cost to construct a single championship green is \$60,000.

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The visible surface of a putting green is just the tip of the iceberg. A well-built green starts with 4-inch herringbone drains cut into the subgrade, or base soil, about 18 inches below the turf. A 4-inch pea-gravel "blanket" then covers the base. On top of this blanket at SHCC, RadiantPERT tubing was laid at 9-inch centers. The final layer is a "greens mix" of sand and peat, then seeded with Creeping Bentgrass.

Maintaining efficiency, atmosphere

Limiting upfront cost through careful design was only one need among several that TSI and Watts were tasked with. Quiet operation, energy efficiency, and aesthetics were equally important.

The heat pumps were custom designed to meet SHCC's requirements. Each unit contains multiple compressors and refrigerant circuits, modulating up or down to match a changing load. All fans are ECM-powered, offering high efficiency, variable-speed control and low-noise operation. Sound-insulating covers were installed on the compressors and louvers, and offsite control is provided by a full DDC control system.

Each of the four TSI air-to-water heat pumps also have an integrated variable-flow pump located in an insulated cabinet along with a brazed-plate heat exchanger and control valves. This eliminates unsightly outdoor pump skids or the need for separate mechanical rooms. Finally, after the units were factory tested, they were painted green to minimize visual impact.

Once the systems were installed, startup was a collaborative effort on the parts of TSI, Boone Sales and Soder Mechanical, a subcontractor hired by SHCC.

Play through

"This was a learning process for all of us," Pestel says, "but the design phase was greatly simplified because of Russ Myers' past experience with surface conditioning at golf courses."

Myers likely knows more about golf green conditioning than anyone else in the country. The first commercial hydronic green conditioning system of any merit was installed at Augusta National Golf Club in the 1980s, where Myers was employed in the late 1990s. Starting in 2010, he installed two similar systems at the LA Country Club. In 2016, he returned to SHCC with the experience he'd gained.

"There are a wide variety of green cooling techniques used in golf maintenance, from surface fans to water syringing," Myers explains. "There's even a method of forcing cool or warm air through the green's drainage system. The hydronic system installed at SHCC provides the greatest benefit available in terms of controlling climatic conditions."

"There's no question the investment made by the club will pay dividends year-round. It allows for more play and higher-quality surfaces. Our members hope to play golf whenever they can, and this increases that possibility. It's a major differentiating factor for Southern Hills Country Club."

Myers adds: "While I've been a part of installing this system multiple times, the real credit goes to the club leadership at Southern Hills. Every superintendent would love to be able to manipulate the temperature of the soil with hydronics. This club's leadership is forward-thinking. Without great general managers and club boards of directors, these advancements would never have occurred." **pme**

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