Georgia Resort Controls Humidity with High-Efficiency Ventilation System

By Becky Busby

Callaway's 14,000-acre gardens, resort, and preserve offer guests a wealth of attractions including a butterfly center, nature trails, bicycling, swimming, fishing, golf, fitness activities, and eight restaurants. Callaway, located southwest of Atlanta in Pine Mountain, also features a variety of accommodations such as cottages and villas.

Photo courtesy of Callaway Gardens

But the 349-room Callaway Inn, consisting of three mature buildings, had humidity control problems due to the environment. "In South Georgia, high humidity goes without saying," explains Ben Elkin, the engineer who was called in to fix the problem.

Renovation of the building's HVAC system included installation of two Pinnacle® ventilation units manufactured by SEMCO Incorporated. (Columbia, MO). The Pinnacle units have kept the Callaway Inn rooms at a constant humidity set-point of 54% relative humidity, no matter what the conditions outdoors. Also, the system is twice as efficient as conventional alternatives, which translates to lower HVAC operating costs.

"The Pinnacles solved our problem by providing energy savings and guest satisfaction," says Cliff Strickland, Callaway's Assistant Mechanical Manager, Engineering Department.

Classic Humidity Control Problem

The diagnosis of the problem at the Callaway Inn was simple. High humidity in the space was causing mold and mildew, dampness in the walls and bedding, and condensation on the windows, especially when guests were using the showers. Wallpapering failed to fix the problem, since the buildings had undergone numerous remodeling designs over the years, and moisture had accumulated in the layers.

The Inn is a traditional motel-type structure with three, two-story connected buildings, or wings. Room access is from the outdoors, with no central hallways. The chilled-water HVAC system, including old fan-coil units, did not have enough latent capacity to remove moisture from the outdoor air.

In an earlier attempt to improve efficiency, a contractor had installed variable-speed drive on the chilled-water pumps, but the head pressure on the pumps became so low that not enough chilled water was going through the coils. Humidity in the space got even worse, with levels of over 97% RH.

Callaway was most concerned with the effect on its customers. Guests who were familiar with the Inn were requesting rooms in one particular building where the dampness was less severe than in the other two wings.

Seeking to fix the problem once and for all, Callaway heard about a successful project at Georgia's Berry College, where Ben Elkin had installed several of SEMCO's new Pinnacle units. Elkin, Physical Plant Director at the college, recommended Pinnacle ventilation systems to Callaway.

"They just wanted dehumidification, and the Pinnacle has superior efficiency," says Elkin. "The supply air from outdoors becomes the exact temperature as the exhaust air, which is unique."

The desiccant-based system delivers fresh outdoor air at dewpoints much lower than can be obtained with conventional cooling. John Fischer, SEMCO R&D Director, explains, "The Pinnacle is unique in that it de-couples, or handles, all of the latent or humidity load in the building – from outdoor air, infiltration, people – through just the outdoor air volume."

Design and Installation

The original building design incorporated a 12-inch plumbing chase running down the middle of each wing, with a double stack of rooms on either side. The existing conventional cooling system included ceiling-mounted PTACs (packaged terminal air conditioners) and a 600-ton central electric chiller plant with variable-air-volume controls; outdoor air was mixed with return air and then cooled.

Distribution of dry ventilation air was an engineering challenge, due to the limited space between the rooms and the chaseway. Elkin decided that new ductwork had to be installed, including new holes in the room walls.

Pinnacle PVS-3 units, with a capacity of 3,000 cfm, were placed on the roofs of the two buildings with the more severe humidity control problems. The existing chase exhaust plenum was utilized, and new high-pressure 6-inch ductwork was run from the units, going down to 3-inch round ducts into each room.

The ventilation system was designed to be stand-alone, rather than completely integrated with the buildings' existing chilled-water PTAC system. Instead very dry, fresh air is introduced directly into the space.

Immediate Results

As soon as the Pinnacle units were installed in two of the three wings, Callaway's guests noticed the difference. They began requesting rooms in the two buildings with the new ventilation systems, rather than the wing that previously had been less damp. "Our customer reaction since then has been no calls, which means no complaints" says Callaway Gardens' Cliff Strickland. "Guest satisfaction has been a goal from the start."

In addition, the ventilation system immediately reduced the cooling load on the electric chillers, allowing them to shut off periodically, which reduced utility demand and energy charges. According to Strickland, "We calculate that we saved $15,000 to $19,000 per year from chiller operating cost reductions."

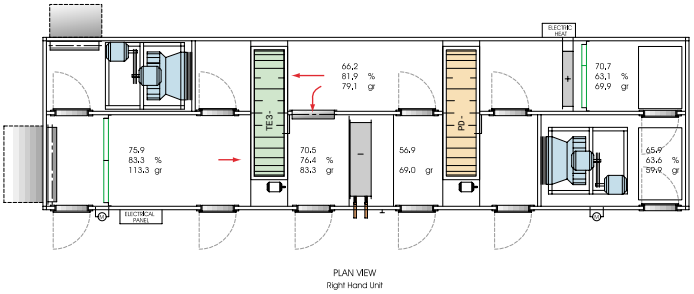
Since installation, the Pinnacle units have maintained humidity in the space at or below a dewpoint of 57 degrees (70 grains), which corresponds to a maximum space condition of 76 degrees and 50% RH, regardless of increasing moisture in the outdoor air. The system is modulated to maintain constant humidity rather than ramping up and down.

Ben Elkin says, "From day one, the Pinnacle ventilation system has worked like a top. It's provided a fresher indoor air environment and has eliminated odors and dampness."

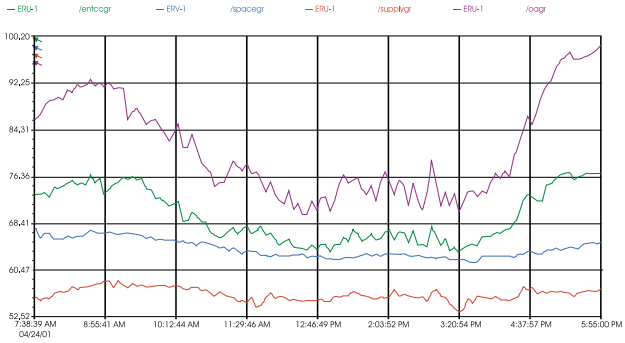
Due to the success of the first two units, Callaway decided to install a third, experimental unit incorporating a new technology being developed by SEMCO with support from the U.S. Department of Energy.

Optimizing Performance

SEMCO continuously monitors and optimizes the performance of the Callaway units using the system's fully instrumented direct digital controls with remote access via modem. Examples of SEMCO's monitoring data are shown in Figure 1, which provides a snapshot of Pinnacle performance during part-load conditions, and Figure 2, which quantifies how well the space humidity is controlled despite an increase in outdoor air humidity. In Figure 2, all of the work from the purple to the green line is accomplished by the Pinnacles' desiccant wheels, as well as most of the work from the green line to the red line.



PLAN VIEW
Right Hand Unit



"Passive" Desiccant Wheel Boosts Efficiency

The Pinnacle PVS series units incorporate a new, passive dehumidification wheel that requires no active heat source to regenerate the desiccant material and no evaporative cooling section. The desiccant is optimized to remove moisture from a saturated air stream, that is, the condition leaving a cooling coil, using only the energy in the system's return air. Figure 3 shows a schematic of the PVS system in typical dehumidification mode of operation.

The Pinnacle unit is twice as energy-efficient as any other comparable product and has the unique ability to dehumidify outdoor air streams to very low dewpoints unattainable with conventional cooling approaches. The system allows for precise control of indoor space humidity while delivering high quantities of outdoor air at both peak and part-load conditions and during both occupied and unoccupied modes.

The system's very high degree of latent cooling reduces the amount of conventional cooling input required. For example, in the snapshot of part-load performance shown in Figure 1, a conventional system would have required 16 tons of cooling to reach the conditions shown, with approximately 29,000 Btu of reheat. In contrast, the Pinnacle provides free reheat and requires only 6 tons of cooling. At design conditions, the cooling capacity savings are even greater.

As a general rule of thumb, 10,000 cfm of Pinnacle capacity provides as much as 50 tons of latent capacity (68 tons of total capacity) with an input of only 32 tons of refrigeration. Conventional cooling would require a 15,000 cfm system with 90 tons of refrigeration plus reheat energy to deliver the same performance.