2002 DESIGN/BUILD AWARDS
CONTRACTING BUSINESS

Category D

DRUG COMPANY'S Project Gels *with Design/Build*

TROPIC AIR CONDITIONING, Miami, FL

by Michael S. Weil

If you've ever popped a vitamin or Betacarotine tab, chances are the outer coating was a gel cap produced by Swiss Caps USA. Based in Switzerland with a U.S. manufacturing facility in Florida, Swiss Caps is a pharmaceutical company that specializes in manufacturing gelatin capsules.

When the company decided to build a 50,000 sq.ft. state-of-the-art manufacturing facility in Miami, Florida, company executives left the mechanical system design in the hands of the building architect. Unfortunately, the architect found himself in over his head, even after hiring an engineering firm to handle the details, so Swiss Caps officials officials began casting around for a contractor to take over the process.

Swiss Caps Senior Project Manager Siegfried Schwab found just the right contractor when he was introduced to Scott Gordon, president of a Miami-based Design/Build firm known as Tropic Air Conditioning.

Gordon, a second-generation owner who, along with his brother, bought the 43-year-old company from their father, rose through apprenticeship programs and on-the-job training to become quite a fan of the Design/Build process.

"The manufacturing of soft gelatin capsules is a high-tech process requiring clean rooms," he explains. "Clean rooms are complicated, having fairly strict requirements set forth by the U.S. Food and Drug Administration. They require a wide array of skills and expertise in terms of mechanical system design. The Design/Build process is perfect for such a project."

Gordon adds that the engineer originally chosen

The Swiss Caps plant had Class 100,000 clean rooms that require up to 30 air changes/hr. Combining existing air handlers with an enthalpy wheel saved size and energy. Here you see an air handling unit with a variable frequency drive to maintain air flow as the HEPA filters load up.

to put this project together had never faced the complexities of a pharmaceutical clean room.

Schwab says his company was looking for a cost-effective design and alternative solutions for the multiple HVAC needs this project presented.

"Schwab is very knowledgeable in all aspects of construction," Gordon says, "especially HVAC, electrical and plumbing. He provided us a basic floor plan with equipment heat loads for each room. The facility has several processes going on at one time, all requiring drastically different cooling requirements. Working with Antonio Franyie, our consulting engineer, we ran block loads on the entire building. A preliminary set of drawings was created in our office for bidding purposes and during an 11-month period, six proposals were submitted. The seventh was approved."

Scott Gordon, president of Tropic Air, conducts air balancing in the Swiss Caps clean room and commissioning on the chillers in the mechanical room.

The project was completed in December, 2000. The base contract for HVAC was $980,000. Additional process piping was performed for $410,000. The process piping included vacuum, compressed air, nitrogen, sorbitol, gelatin, and glycerin. Welded stainless steel piping with removable clamps for cleaning was used on the sorbital, gelatin and glycerin piping.

Conquering the Specifications

The Swiss Caps mechanical system had to handle six key areas of environmental control. One of the most important involved the area where the gelatin caps themselves are manufactured. These areas, known as *encapsulation rooms*, have a large amount of moisture added to the air as a result of the manufacturing process. Gordon says this requires very dry air to absorb the latent load.

"The encapsulation machines require process cooling of air and water to operate properly," he explains. "The static pressure drop across each encapsulation machine is 3-in. WG, requiring custom made coils, and high static fans to handle the airside cooling."

Gordon and design engineer Antonio Franyie explain that the chilled water, process-side cooling is supplied from the main chilled water loop and a shell-and-tube heat exchanger. The process loop uses a custom-made stainless steel storage tank.

"Because the casting drums can't handle more than 15 PSI, a vent line in the return piping is designed into the installation to maintain a maximum pressure in the loop of 12 PSI," Franyie says.

The next key area in the design involved areas where the gel capsules are dried. Schwab says drying was accomplished by rotating capsules in special motorized tumblers.

"These areas are known as *drying rooms* and they require air entering the room to be at around 5% RH to maintain a 21% RH room setpoint," Gordon says. "We used a desiccant gas-fired dehumidifier with chilled water post-cooling to handle the high latent load (140 pounds per hour of moisture at full load) in the drying rooms."

Due to the high static pressure going through each tumbler, Gordon and the Tropic Air team opted to use a primary/secondary air circulation design. Gordon explains that a Munters gas-fired dehumidifier supplies 9,000 CFM of air into the rooms at around 5% RH. A direct digital control (DDC) system monitors relative humidity inside the drying room and controls the gas valve on the Munters unit.

"Our commissioning process has maintained the drying rooms to within 0.5% of setpoint," Gordon continues. "We installed large industrial fans above the ceiling to pick the air up from

CATEGORY D

NEW CONSTRUCTION OVER $500,000

WINNER AT-A-GLANCE

Project Name/Location:
Swiss Caps USA, *manufacturing facility, Miami, FL*

Key customer contact:
Siegfried Schwab, *senior project manager*

Contracting Firm Principal:
Scott Gordon, *president, Tropic Air Conditioning, Miami, FL*

Nomination submitted by:
Scott Gordon, *Tropic Air Conditioning, Miami, FL.*

THE PROJECT TEAM

At Tropic Air Conditioning
- Scott Gordon, project manager and controls
- Rajendra Persuad, field supervisor and controls
- Johnny Muniz, pipe fitter
- Mike Formosa, pipe fitter

At Swiss Caps USA:
- Siegfried Schwab, senior project manager
- Antonio Franyie, PE, design engineer, Franyie Engineers, Miami, Fl.

At Sheet Metal Sub Contractor
- Duct Shop, Miami, FL
- John Jones, president
- Carlos Flores, project manager

At Insulation Sub Contractor
- Low Country Insulation, Boca Raton, FL
- Roger Crawford, president

the room and distribute it into a galvanized sheet metal header duct with a PVC riser distribution system installed in the walls of the drying rooms.

" The tumblers are rolled into place against the wall and are provided dry air from a 6-in. PVC elbow inside the wall. The secondary fans provide constant air circulation through the tumbler.

" Since the requirement for the encapsulation room is 50% RH, the return from the drying room is around 21% RH, and is supplied into the return of the chilled water air handler for the encapsulation room. The encapsulation room return is then tied back into the dehumidifier process return air duct."

The clean room control panel: Each zone is controlled through the direct digital control system.

Clean Room Design

There are Class 100,000 clean rooms in the pharmaceutical production area with pressurization requirements to maintain the cleanliness of the air. Plus, according to Siegfried Schwab, the area requires 30 air exchanges per hour.

Two rooms within this area required 100% exhaust air at 5,000 CFM.

Gordon says, " We used an enthalpy wheel to minimize the heat load that would have been placed on the air handler and chiller by adding the additional 5,000 CFM of outside air." He adds that if they didn't use the wheel, the air handler would need to be increased by 30 tons to handle the additional outside air load.

" The air handlers have double wall construction and HEPA filtration with 35% pre-filters and 95% intermediate filtration," Gordon continues. " The common area air handler uses HEPA supply air diffusers, while the air handler for the drying room uses 12-in." HEPA filters on the discharge air sec-

CATEGORY D NEW CONSTRUCTION OVER $500,000
PROJECT AT-A-GLANCE

SYSTEM DESCRIPTION:

Swiss Caps USA, a pharmaceutical manufacturer based in Switzerland, specializes in manufacturing gelatin capsules such as vitamins and Betacarotine. The company was planning to construct a 50,000 sq.ft. state-of-the-art manufacturing facility in Miami, FL. The project was initially being totally designed by an architectural company that had subbed out the mechanical system to an engineering firm. Unfortunately, the engineering firm had never designed a system with the exacting requirements a pharmaceutical manufacturing facility needed.

When Scott Gordon first got wind of the situation through a former employee of his company, Tropic Air Conditioning, he decided this was the job for him. He contacted Swiss Caps and began an 11-month design process that landed him the mechanical system job.

Tropic Air, a 43-year-old, second-generation, family owned contracting firm started by Scott's father, Cal Gordon, specializes in complicated process and comfort systems. The Swiss Caps building was a major challenge. The factory was to have several processes going on at one time, all requiring drastically different cooling requirements.

After six proposals and many meetings, Gordon, along with Swiss Caps Senior Projects Manager Siegfried Schwab, worked out the details of the design.

PRODUCTS KEY TO SUCCESS

- Three Dunham Bush 125 ton water-cooled rotary screw chillers, model WCFX12.
- Seven York chilled water air handlers. Two air handlers for the pharmaceutical area had double wall construction.
- One Munters 9,000 CFM gas fired dehumidifier for large drying room. Controlled by Johnson DDC System.
- One ATS 4,000 CFM gas fired dehumidifier for clean room drying room. Controlled by Johnson DDC System.
- One Econovent AB 5,000 cfm enthalpy wheel for 100% exhaust and makeup air in clean room.
- A Johnson Control N-31 supervisory control system with M3 workstation and color graphics. Energy consumption monitoring for one electric meter, two gas meters and two water meters is programmed into the system. Pulse meters are used to calculate total energy consumption.
- Four Danfoss Grahm VFDs for air handler fan control. Monitored through the Johnson N2 communication Buss and M3 Workstation.
- Nailor Hart VAV using Johnson DDC actuators. Communicates with the M3 Workstation for zone control in medicine prep area and general offices.
- Evapco cooling tower. Two cell, two fans.
- Bell and Gossett pumps. two chilled water, two cold water. 100% backup.
- Acme fans.
- Eight Trane air-cooled roof top package units.
- Johnson N-31 supervisory controller and various Application Specific Controllers (ASC), were installed, programmed and commissioned by Tropic Air Conditioning.

Air/water separator and vacuum pumps.

tion of the coil."

Franyie adds that they used variable frequency drives (VFD) on the air handler fans to maintain airflow as filters load up. "The VFDs are monitored through the Johnson Control system. With the filters clean, the VFD will be at approximately 75% speed. As the filters load up, the VFD increases the fan speed to maintain constant airflow and the proper air exchange rate."

Tropic installed Magnehelic gauges to monitor room pressures with a 4-20 mA transmitter. The room pressures are critical, with the clean room corridor slightly higher to the adjacent rooms and hallways. The system maintains a positive pressure of .05-in. wg differential between areas of high cleanliness and those with less clean requirements, with all entryways closed. With an entryway open, fan capacity is adequate to maintain an outward flow of air to the lower level space.

Antonio Franyie says because of various internal heat loads from equipment within the clean room area, duct-mounted chilled water coils were added for five zones.

"Each zone is controlled through the DDC system and sends a 0-10 VDC signal to modulate three-way valves for each coil," he says. "This allows us to use one unit that supplies air throughout the clean room and still maintains constant volume and temperature with drastically different heat loads in the zones throughout the clean room area."

In addition to encapsulation rooms, clean rooms, and dry rooms, the Swiss Caps facility also has a washing area requiring exhaust air. This is controlled by relative humidity transmitters that open outside air dampers on associated chilled water air handlers to offset exhaust air and start exhaust fans when the room RH goes above 60% control. The supply air into the washing rooms and outside air to the chilled water air handler goes down to a minimum CFM when the exhaust fan is not operating.

Other Considerations

Besides the manufacturing area, the Swiss Caps facility maintains some laboratory and office space as well. Tropic Air was responsible for designing and building the environmental system there as well. The lab consists of two fume hoods, complete with compressed air and nitrogen. Gordon says it has a separate chilled water air handler and is under a positive pressure of .05 in. wg.

Several air-cooled roof top package units supply the warehouse and west offices.

Tropic Air Conditioning performed the test and balance with assistance from Darrell Hermans with TAB Services.

"Since we are able to provide full mechanical, controls, startup and balancing services to our customer, the commissioning process was always at the forefront. Equipment was set with accessibility for service, duct and piping installed, controls programmed and commissioned with the original design intent in our mind the entire time," Gordon concludes.

"Due to the project being Design/Build, most problems were found and solved during the time of design," he adds. "Field problems were addressed immediately knowing we had full and ultimate responsibility to make sure the design intent would be satisfied and the project would stay on track. One of the main benefits that I see with Design/Build is that there is no finger pointing. The contractor has total responsibility for the project." ■

Drying rooms required dry air entering them to be at 5% RH to maintain a 21% RH room setpoint. Pictured here is a desiccant gas-fired dehumidifier with chilled water post cooling.