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Stabilizing Cleanroom Humidity and Temperature

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CASE STUDY:

Stabilizing Cleanroom Humidity and Temperature

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John Garbini had tried almost everything. As facility support manager for an assembly plant in Reading, Pennsylvania, he was stuck with a nagging problem: When the humidity in the plant's Class 8 cleanrooms wasn't too high, it was too low.

He had tried dehumidifiers. He had tried a large industrial desiccant unit. Balanced dampers? Reduced air pressure? Been there, done that.

Angiotech, a pharmaceutical specialty and medical device manufacturer, uses the Reading plant to assemble and package sterile, disposable scalpels and surgical needles with attached sutures. High humidity in the cleanrooms could not only encourage bacterial growth, it could prematurely degrade a type of moisture-activated suture that is designed to slowly dissolve in human flesh after the surgical incision heals. Low humidity, on the other hand, promotes static electricity, which interferes with computerized packaging and labeling equipment and gives employees small shocks.

"Temperature and humidity swings were normal," Garbini recalls. "Our employees were either too hot or too cold. It was a challenge to maintain the proper

Angiotech's Reading, PA, plant where disposable scalpels and surgical needles with attached sutures are assembled and packaged.

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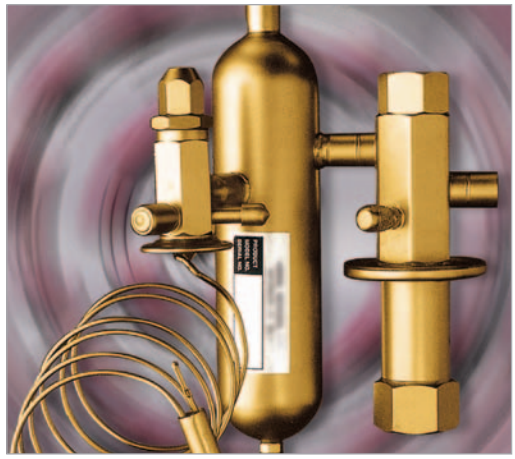
temperature while still dehumidifying the space. The air-handling compressors were constantly slamming on and off, but the main problem was that I could never get the humidity low enough to stay within our specs, which are more stringent than the federal cleanroom standards."

Today, both temperature and humidity are holding steady in Angiotech cleanrooms. The solution came in the form of the APR Control, a device manufactured by Rawal Devices, Inc., of Woburn, Massachusetts. The device smoothly modulates a direct-expansion air conditioning system's capacity, allowing it to dehumidify the space without overcooling it. The device varies refrigerant flow according to suction pressure, which changes with the temperature of air crossing the evaporator coil. Because it continuously monitors the heat content of return air, it maintains the system in a dehumidifying mode more efficiently than thermostats and humidistats and without risk of coil icing, liquid slugging, or excessive compressor cycling.

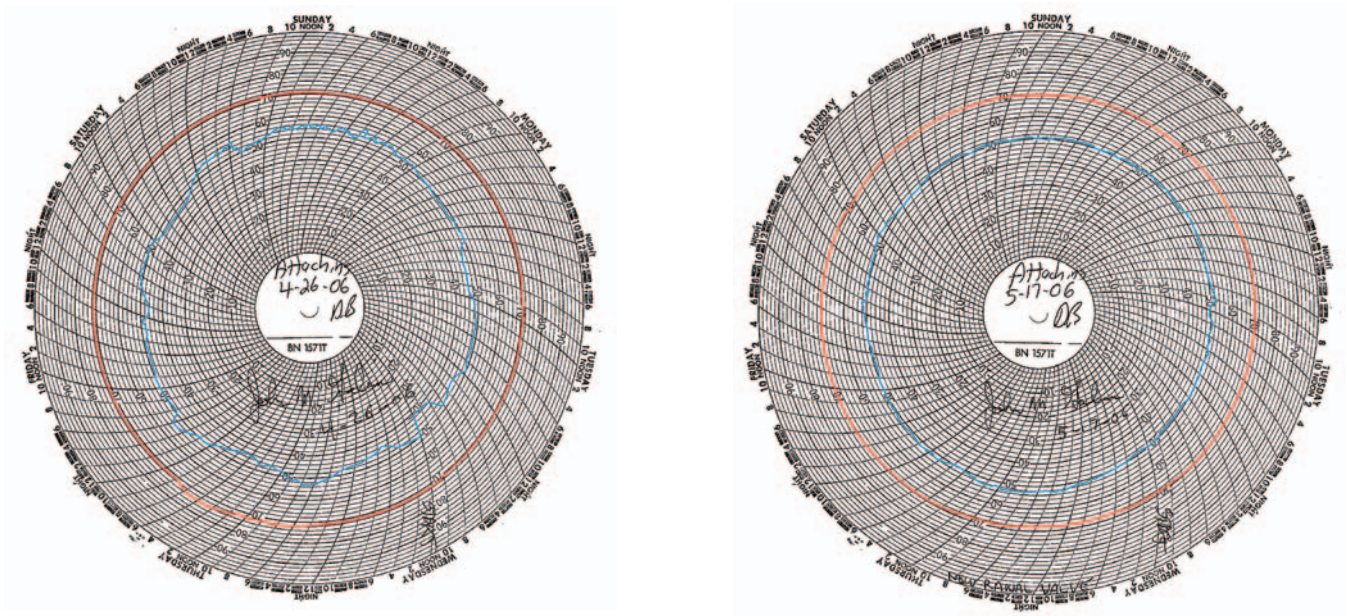
As service manager for The Warko Group, Angiotech's local HVAC contractor, I had been recommending this device for years, but Garbini had not found room for one in his budget. Finally, he purchased the device along with a new air handler for the troublesome cleanroom (the one where the needles with moisture-activated sutures are packaged). It was installed in late December 2005, when the plant was shut down for the holidays. At last, Garbini was



The device allows an air conditioning system to dehumidify without overcooling.

able to keep the room at 20–50% relative humidity regardless of the weather outdoors. He calls the device "Little Pauly," after Paul Gardner, the amiable Warko Group mechanic who installed it.

"The APR Control is running great, with no problems at all," says Garbini. "It made such a significant impact that we installed another one in the air handler for the other cleanroom in May 2006. Now we're now maintaining ➤



Charts tracking humidity (blue inner plots) and temperature (red outer plots) for two different weeks in the spring of 2006 show how the device conditions in a cleanroom at the Angiotech plant in Reading, PA. Before the May 2006 installation in the plant's standard package rooftop HVAC system, relative humidity was up and down throughout the week (left), but for the week following the installation (right), it remained at or about 50%. Temperature was already fairly stable (at or about 70 °F) before the installation, but was even more stable afterwards.

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humidity and temperature in both rooms well within specs, our employees are more comfortable, and I've even seen a decline in the electrical energy consumption."

The story behind the story: To allay any doubts that the improvements from the first installation were due to the device (rather than the brand new air handler) and to demonstrate its effectiveness once and for all, I persuaded Vice President Richard Rawal to donate the second unit. The results were enough to finally convince Angiotech's upper management. Garbini recently ordered a third device for the finishing department, where the needles and blades are polished, cleaned, and washed before going to the cleanrooms for assembly and packaging. Though not an official cleanroom, this area requires frequent air changes, HEPA filtration, and, of course, stable levels of temperature and humidity.

A typical HVAC system is designed for a sunny 95º day with 95% relative humidity. On cooler days, because the system has more capacity than it needs to satisfy the actual load, it tends to cycle on and off. When it shuts off, the humidity increases, causing the room's occupants to feel uncomfortable even when the temperature is within the desired range. Occupants tinkering with the thermostat only make things worse.

The device improves an HVAC system designed for on/off operation by allowing it to "track" the load — to operate at the same capacity as the load. In other words, a compressor pumps only what it is rated for, but the device "de-rates" the evaporator coil for a reduced load. Reduced compressor cycling means energy savings and less wear and tear on the compressor.

In a system equipped with this device, even if a filter is clogged or a belt malfunctions, coil temperature never falls below freezing. With no coil icing, the building is spared the water damage often caused by melting coil ice. The device is also used for high-percentage (up to 100%) make-up air systems, reducing the cycling caused by wide variations in the temperature and humidity of outside air.

Bob Reichenbach is HVAC Service Manager for The Warko Group. He has 38 years of experience in the design and service of commercial and industrial HVAC systems. Rawal Devices, Inc. can be contacted at P.O. Box 2058, Woburn, MA 01888, Toll-Free: 1-800-727-6447, Tel: (781) 933-3304, Fax: (781) 933-3306, www.rawal.com.