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Enlisting UV To Battle Mold In Hospitals

By Jack Sine


The UV light installation was not an easy one at Henry Mayo Newhall Memorial Hospital. There was no way to access the coil area.

Hospitals in the U.S. Sun Belt need their air conditioning equipment operating 24/7/365 to keep patients and staff comfortable. They also want it to operate at maximum efficiency to keep the administrators comfortable. Maintenance personnel servicing these units face a challenge because maintenance requires time, and, at times, downtime.

Two hospitals located in hot climates — one in a high-humidity environment, the other in low humidity — have turned to ultraviolet (UV) light to solve many of their maintenance and efficiency problems.

Artificially produced UV light waves in the C band (UVC) have been used for nearly 100 years as a very effective germicidal force in water and on surfaces — and, more recently, in air conditioning systems to reduce infectious microbes. But the key to improved air conditioner efficiency lies in UV light's ability to improve heat exchange efficiency and reduce maintenance by eliminating mold and mildew from coils.

Since the 1990s, UV use on coils has spanned the spectrum of occupied spaces, including hospitals. When installations of these systems are viewed geographically, the greatest numbers of them exist in the Sun Belt, predominantly in areas of high humidity. Their use could be much broader.

Indoor Humidity Counts More Than Climate

The cause of mold and mildew formation on coils has little to do with the outdoor relative humidity (rh). Only the rh of the indoor air is relevant. Hospitals must maintain a comfortable and safe level of relative humidity.

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) *HVAC Applications Handbook* recommends 30 percent to 60 percent rh for most areas and, in more critical areas, 45 percent to 55 percent. These levels are achieved by either removing moisture in humid environments or humidifying dry environments.

It is important to note, however, that to the A/C system in either a dry or humid climate, the humidity of the indoor air will provide ample moisture to create a very friendly environment for mold and mildew, both on the coil and in the drain pan.

Texarkana, Texas, is a typical high-humidity environment where the moisture in the outdoor climate itself can make mold and mildew a constant problem. It gets worse when the ambient moisture combines with airborne organic particles.

The combination will plate out on the A/C system coils and other surfaces during the condensation process and then bind together to create different types of problems.

For example, when the material amasses on a coil's surface, the heat flow rate (transfer) degrades. In addition, the contaminated coils will start a proliferation of microbial activity. This was the problem faced by St. Michael Hospital in Texarkana.

Unlike hospitals in arid climates, those in humid climates must dehumidify the outdoor air to maintain the relative humidity at ASHRAE-recommended levels.

"Mold and mildew are pretty much a constant in this climate," said Ed Marion, director of facilities at St. Michael.

"They get in the coils and our cooling efficiency goes down. In the cooler months that isn't a serious problem, but at the peak temperatures of summer you have to have air conditioning systems working very efficiently to keep everyone comfortable. You also have to have the right amount of moisture in the air.

Marion noted that between the hospital and the office space, his staff had to care for more than 900,000 square feet of space.

“I read an article about using ultraviolet light to keep coils clean, and it made sense to me. That’s just about when one of my suppliers, Dwight Bailey, started acting as a representative for an ultraviolet light company.”

Bailey is the president of Air Filter Systems Inc., an Arkansas-based rep firm. “I had just started to represent UltraViolet Devices Inc. (UVDI) when I talked to Ed about it. Since Ed and I had been doing business for a long time, we developed a mutual trust and he already had an interest. Ed agreed to put a UVC system in one of his units.”

How UV Keeps Coils Clean

“In almost any climate, an air conditioning unit has the capacity to condense moisture from the air,” said Forrest Fencl, director of UVDI, Valencia, Calif.

“Whether the air has been artificially humidified, as is done in arid climates, or the air has been dehumidified from the cooling process, as is found in humid regions, there is more than enough moisture to support the growth of microbial contamination.

“When the air around the coil hits its dew point, it will condense on the coil’s surface, and, if there is enough of it, the water will run down the coil’s fins and into the coil’s drip pan,” Fencl explained.

“In the moist environment of the coil and on many surfaces just past the coil, mold, mildew, and possibly some bacteria will develop in almost every case. Once the microbes are established, the colony formations absorb and hold moisture to maintain hydration and increase development.

“As the growth cycle continues, the accumulation of mold and mildew severely degrades heat transfer performance.

“In addition, the colony formations release metabolites from their metabolism into the air, including dead cell wall materials, gases, and newly created spores — airborne contaminants that are undesirable in any building, and especially so in a hospital.

“Fortunately,” Fencl said, “ultraviolet light kills mold, mildew, and bacteria. Once dead, they flake off the coils and restore the heat exchange efficiency.”

The Results

The UV system Marion decided on initially was installed in the proximity of a modular Trane central station Climate Changer. This system was installed to cool the hospital's surgery unit, but it had been losing efficiency as the coils began to accumulate dirt, moisture, mold, and mildew.

Marion said he thought he had solved the problem by adding a DX coil to the system, but it, too, accumulated mold and debris. Its performance degraded as well.

“I had been searching for some way to restore this system’s efficiency again,” said Marion, “and from what I read and what Dwight told me, UV seemed like the best solution.”

Bailey sized Marion’s system using software produced by Penn State University. He also consulted the UVDI factory and together they determined that a V-Mod UV system consisting of six UVC fixtures could be located between the air discharge side of the chilled-water coil and the air inlet side of the newer DX coil. In that manner selected, the configuration of the lights would treat both of the coils at the same time.

“There was only 23 inches between the coils,” said Bailey, “so we positioned the lights one over the other on one row and facing upwards on the other row to achieve an inexpensive method of producing 360-degree distribution of UVC energy.”

The fixtures came with their own mounting rails and UL/NEC-approved hard-wired modules, allowing the fixtures to be slid in and out from outside the A/C unit.

Bailey ran some tests before and after installation.

“We installed the UVDI system in July, did our tests, and came back in September to take our second set of measurements,” he said. “The inlet air wet-bulb temperature went from 58 degrees F in July to 60.8 degrees in September; the outlet air wet-bulb temperature went from 48 degrees to 46.4 degrees. This was accompanied by an increase in airflow of 1,785 cfm. Clearly, the system's net cooling capacity was increasing.

“Going strictly by those numbers,” Bailey continued, “St. Michael's could conserve enough energy to pay for the UV install in less than eight months — even faster if they were to factor in their maintenance savings.

“They were, however, desperate for increased cooling capacity from this system, so those energy savings may not be realized, but they are extremely happy to have the system running at peak efficiency and giving them the additional cooling they need.”

UV In An Arid Climate

Henry Mayo Newhall Memorial Hospital is located in Santa Clarita, Calif. The landscape there is technically described as upper desert. The climate has a very low specific humidity almost all of the time.

Minimal cuts were made into the unit’s

“There was no identifiable problem with their air conditioning systems according to the hospital's staff," said Fencl.

exterior panels at Henry Mayo Newhall Memorial Hospital so the UV fixtures could be positioned properly in relation to the coil.

"They had read some articles about UV in trade magazines and, although they were skeptical about its value, they wanted to give it a try. Because our headquarters is nearby and because we've developed a very constructive relationship with the hospital's administrative team, they entrusted us to install UV in one of their systems for evaluation."

UVDI fixtures and lamps were installed in a Carrier unit commissioned in 1975.

"The system serves patient rooms, where comfort is a real issue," said Richard Londergan, the hospital's maintenance/engineering superintendent. "After the UVC was installed, there was an almost immediate decline in pressure drop across the coil. Combine that with the fact that we don't have to clean the coil and drain pan anymore, potentially there's both increased efficiency and savings. It is safe to say that we will be installing more UV as our budgets allow for it."

The installation was not an easy one. There simply was no way to access the coil area.

"We made minimal cuts into the unit's exterior panels so the UV fixtures could be positioned properly in relation to the coil," said Fencl.

Technicians installed UVDI glass access doors in two neatly cut holes to enable hospital engineers to routinely inspect both the coils and the lamp fixtures. The doors also give access to the UV fixtures themselves so bulbs can be easily replaced annually.

"We usually install these fixtures in as little as 20 minutes each, but this one took a little longer because of the need for the access doors," Fencl said. "Fortunately, we stock a variety of doors like these just for situations like this. Once we had everything up and running, the results were fairly dramatic for this environment."

"We're very happy with it so far," said Londergan. "We certainly wouldn't have thought that mold and mildew would grow in this dry climate, especially to the point where it would affect the systems heat transfer efficiency and airflow, but the numbers speak for themselves. Of course, we do add moisture to the air from our humidifiers to meet both State of California Title 24 standards and ASHRAE guidelines.

"UVDI performed some standard tests before and after installation. The results were so impressive, we're planning to put UV lamps in all of our air handlers. It's much better than chemicals for cleaning coils and drain pans and keeping them that way. Of course, in our case with the lack of access, it's often our only way."

Before installing the lights, the wet-bulb temperature for the inlet air was 60.4 degrees and the outlet was 54.5 degrees for a 5.9 degree differential. Pressure drop across the coil was 0.65 inches water gauge (wg).

After a couple of months of UVC treatment, testing showed an inlet air temperature of 58 degrees and outlet temp of 51 degrees for a 7 degree differential. Pressure drop across the coil dropped to 0.60 inches wg, yet there was an increase in cfm of 1,491. When the system's cooling mode operation of 6,570 hours per year gets factored in, the potential starts to add up.

"We estimate that the increase in performance could equal a reduction of about $3,641 in kWh consumption," said Fencl. "That means that in pure work energy, the increase in net cooling performance over a seven-month period of time would be equal to their total investment outlay to equip the system. From then on, any saving is icing on the cake."

As more hospital maintenance teams are learning of the advantages of UVDI fixtures for coil cleaning, look for more of these applications in all types of climates. Remember, it's not the climate that counts; it's the indoor environment.

Sine is a freelance writer specializing in the HVAC marketplace. He can be reached at jack.sine@verizon.net or 845-838-1466.

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