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UVC Finds Its Cool

GERMICIDAL ENERGY IS A MULTI-TASKER

By Robert Scheir

At a Toronto nursing home this fall, 20 patients died and many others were hospitalized following an outbreak of legionnaires' disease. Investigators confirmed that the outbreak originated in the building's air conditioning cooling tower, when droplets contaminated with the bacteria were distributed into the air by the cooling system and then sucked into the ventilation system's air intake.

In Montreal last summer, an infestation of Aspergillus mould is blamed for the infection of two patients. A Health Canada report documents 24 cases of acute-care hospitals that were similarly infested with the fungus after construction renovations. Hospital ventilation systems are implicated in the development of these outbreaks.

Health officials throughout Canada and the world are currently seeking control strategies to cope with a widely anticipated bird or avian flu pandemic. If the virus achieves the mutated form that could cause a pandemic, it will be highly infectious, with the capability to spread person-to-person through the air.

All three issues involve harmful or potentially deadly airborne microbial contaminants—a bacterium, a mould and a virus, respectively. What's more, all three microbes can be effectively treated with the application of ultraviolet-C or UVC lights, which have emerged in the past decade as an effective tool for indoor air quality (IAQ), mould and infection control in HVAC systems.

UVC is a type of ultraviolet energy in the 254-nanometer frequency. The "C" wavelength is the most germicidal in the UV spectrum. This wavelength targets the DNA and RNA of microorganisms, causing cell death or making replication impossible. The UVC energy kills or inactivates microbes, eradicating surface and airborne mould, as well as viruses and bacteria. Output of such devices is measured in microwatts (μW) per square centimetre.

UVC light has been used for decades to kill harmful microorganisms in many applications, particularly for disinfecting drinking water and for upper-air infectious disease applications in room-temperature environments. The older-style, conventional UVC lights used in these applications, however, suffer drastic output losses when exposed to cold or moving air. As a result, in past decades UVC technology has not been popular for HVAC systems.

HVAC APPLICATIONS

This situation changed in the mid-1990s, with the advent in the U.S. of a new generation of devices that were specifically engineered to provide peak output under HVAC conditions. The new generation UVC lights are verified through independent testing to provide output per inch of glass of at least 10 μW/cm2 at 1 metre in a 400 fpm air stream of 7.2 C (45 F).

The devices install readily in any type of air handling system, including existing systems with limited space and/or access. In a hospital or healthcare application with 15–20 air changes per hour, depending on the installation design, UVC energy will destroy 90–99 per cent of airborne microbial contaminants with each pass.

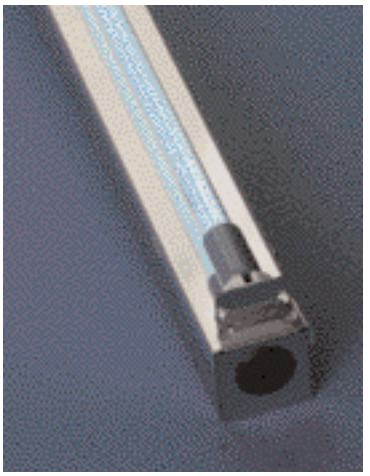
In doing so, UVC reduces the number of microbes to a level significantly below what it would take to infect most people, greatly diminishing spread and infectivity. The germicidal effect is virtually immediate and continuous, as long as the lights are kept on 24 hours a day.

Because it destroys the DNA and RNA of microorganisms, UVC works against all strains of influenza, no matter what their genotype. Examples include Asian flu, Influenza A, Hong Kong flu and Spanish flu. It also destroys other viruses including colds, SARS, measles and German measles; and infectious bacteria including TB, Legionella, pneumonia and whooping cough.

Furthermore, it greatly reduces allergy/asthma symptoms caused by mould and mould spores. Not only does it provide a defensive control strategy for rare or exotic infections, it also prevents the spread of everyday colds, flus and other seasonal illnesses that are an ongoing challenge for healthcare facilities.

ENERGY AND MAINTENANCE SAVINGS

A properly designed and installed UVC system can also deliver energy, maintenance and operational advantages. It can bring back and/or maintain A/C cooling coils to 'as new' condition—and not just



Close-up photo of a UVC light typically used in hospital and healthcare applications.

a product to control infection.

UVC lights are typically installed just downstream of a cooling coil, which also encompasses the drain pan and other damp locations of an air handling system. Here, the high output UVC devices not only zap both coil and drain pan mould and bacteria, they also remove ordinary coil and drain pan debris for significant maintenance and energy savings.

Properly sized and positioned, the devices successfully break down the bio-film and dirt that foul heat transfer surfaces, effectively returning components and thus heat transfer to optimum conditions. This phenomenon provides significant improvements in coil pressure drop and heat transfer efficiency over existing conditions, for predictable energy reductions. User experience shows that HVAC energy savings of 15–20 per cent or higher are common.

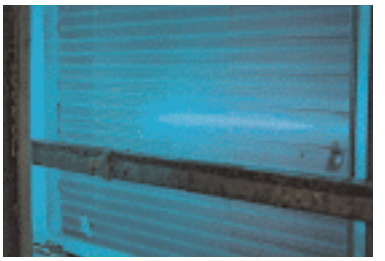
By keeping coils and drain pans clean, another benefit is the reduction or elimination of coil, drain pan and plenum-cleaning programs for significant cost savings. Maintenance crews are no longer exposed to the biocidal agents or cleaning compounds used in these programs.

At one large U.S. acute-care health system—the Orlando-based Florida Hospital system–facilities management estimates energy savings from UVC lights to be in the six figures (U.S. dollars) annually. They have also eliminated hundreds of coil cleaning procedures per year, for thousands of dollars in additional savings. The associated reduction in downtime is also beneficial since the shutdown of an air handling system in any hospital is problematic because it can compromise patient comfort and IAQ control.

SELECTION CHECKLIST

UVC devices for HVAC applications fall into two basic categories: those with the new generation high output lamps, and those with the older-style lamps. Since output decreases on a linear basis over time, it is important to have an accurate understanding of a device's initial output and other characteristics. Here are some questions to ask potential suppliers:

- Has output testing been performed by a certified test laboratory? Although there is not an industry standard for UVC, there are certified test facilities that will perform independent output testing under defined test conditions.
- Are output claims based on HVAC operating temperatures? Older-style lamps are often tested in still air at 32 C (90 F), rather than under HVAC operating temperatures. Warm/still air conditions are very different and will yield more favourable output results for such lamps. Be wary of any output claims that are not based on HVAC-type conditions (i.e., 400 fpm air stream at 12 C or 55 F).



A large hospital air conditioning coil irradiated with UVC lights.

- Are output claims based on tests performed at a distance of one (1) metre? Standard UV output testing is performed with a sensor placed one metre from the light source. Intensity falls off exponentially as distance increases, so some manufacturers test their lights from shorter distances, sometimes as little as 6 inches, to yield higher output readings.
- Are output claims stated "per inch of glass?" Longer UVC lamps yield a higher measured output when compared to a shorter lamp of the same construction. Thus, to get an accurate comparison between different devices, total output of the lamp must be divided by the number of inches of glass. One inch of glass is the common denominator for which to look.
- Where is the UVC device installed? Evaporator (cooling) coils and drain pan areas are the correct locations for UVC installation, as these are the areas of highest contamination. Some devices are designed, instead, for use in the return air ducts. A drawback of such installations is that they allow contaminated air to pass through the occupied space before UVC treatment occurs.
- What are the anticipated change-out cycles? Properly designed high output tubes last 9,000 hours, or one year—about four times longer than many conventional UVC tubes.

Though UVC is an old, well-established technology worldwide, its successful use in HVAC systems is relatively recent. Still, in just a short time, new high output UVC for HVAC devices have demonstrated an impressive ability to improve general IAQ and prevent the spread of infection while keeping coils, drain pans and other areas clean.

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