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# Using UVC to Control Microbial Contamination

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**T**here are three potential categories of airborne offenders that impact IAQ - particles, gas phase compounds and bioaerosols. On the air conditioning side, control methods include a variety of filters, duct cleaning and sanitizing, coating of duct surfaces, total duct replacement, ozone generators or a combination thereof. Despite all this effort, we still have IAQ problems.

But a new device utilizing old technology has proven to be effective in controlling the typical microbial growth on coils and in drain pans and, if properly applied, can do the same for ice machines. This patented device also kills airborne pathogens that circulate through any hvac system.

Before going into details on this product, it's important to understand the scope of the IAQ problem. According to the World Health Organization (WHO),

The term bioaerosol was first used by microbiologists and has since become popular with some IAQ specialists. Bioaerosols are biologically-oriented organic aerosols from living organisms and their metabolic by-products, and they include both mold and bacteria.

In homes and buildings, they originate from two primary sources: people (who carry mold and bacteria indoors) and decay, which is the simple breakdown of organic material, a condition that is occurring constantly in our environment. Mold and bacteria from both sources tend to grow in and around coils and drain pans, causing well-known maintenance headaches.

What we don't always realize is that this growth, in a moving air stream, enables bioaerosols to fill the occupied spaces served by the hvac equipment. What's worse is that this growth almost always occurs downstream of the system's filters, meaning that contaminants must pass through the space before circulating back through the

"the combined effect of all biological air contaminants in indoor air is thought to account for a substantial portion of absences from school and work, as well as days where activity is impaired or restricted." Some researchers and diagnosticians estimate that bioaerosols are responsible for 80 percent of today's allergies.

They arrive at this conclusion based on the ability of biological aero-allergens to sensitize us. Once sensitized, we become more susceptible to many other airborne contaminants.

filters, where often only small portions are then captured.

In the refrigeration industry, growth of mold and bacteria can similarly occur wherever water is present, whether liquid, condensate or vapor. Notable examples are cooling towers and ice machines.

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## [UVC For HVACR](#)

Ultraviolet (UV) light exists as A, B and C energy. A and B are the more familiar forms that can be easily measured outdoors. UVC is the germicidal wave form that is mostly absorbed by our atmosphere and, therefore, can't be measured outdoors. It must be artificially produced with specialty lamps.

These UVC lamps are constructed using quartz (as opposed to glass) to allow the emission of the UVC frequency. UVC is not visible to the human eye: The typical "blue hue" one sees results from the small amount of argon gas used to establish a plasma. It should be noted that the presence of this visual blue light is not assurance that the lamp is producing UVC.

A product utilizing UVC can continuously control the typical microbial growth on coils and in drain pans and potentially can do the same for

Best of all, it's effectiveness is proven. Airborne microbial samplings prior to UVC treatment have been performed and after treatment, no culturable organisms could be isolated. Therefore, UVC has become a reliable remedy for our customers with mold-contaminated systems here in upstate New York.

How does it work? UVC kills microorganisms by attacking its DNA. This attack either kills the cell or makes it unable to replicate (non-reproducible). In either case, the organism becomes non-viable. Also, metabolic processes in organisms cause odors. If mold and bacteria are destroyed, their odors are eliminated. These results occur in as little as two days after installation; in four days, much of the visible mold is gone.

Airborne infectious disease organisms that cause colds and flues, measles, whooping cough, TB and Legionella are

ice machines. This patented device also kills airborne pathogens that circulate through the system, without producing ozone or creating any secondary contamination. Called the UVC Emitter and manufactured by Steril-Aire Inc., this UVC light source is a newly re-engineered version of a 65-year-old technology.

The new device has been designed by hvacr professionals specifically for the industry; it's also simple to install and maintain. Pricing is comparable to that of conventional UVC products with a lower lighting output. However, comparative testing shows that the UVC Emitter puts out more than five times the intensity of lighting compared to older versions previously used in hvacr equipment.

The newer lamps utilize unique electronic ballasts that are matched with specially constructed tubes that come in different lengths and varying fixture styles. They consume less energy than a 75-watt incandescent light. One reason is that the electronic power supply is 75 percent efficient in converting line current to UVC energy.

killed as they fly by the lights. The amount killed on each pass depends upon the dose received, which is affected by cfm and the number of lights. However, even the most modest installation will rapidly reduce the viable number of these organisms in the space, making airborne transmission impractical in just an hour.

Reflectance of UVC energy is important because it allows photons to reach every crevice. In their order of reflectivity, aluminum is excellent, aluminum paint is good, and stainless steel and galvanized sheet metal are fair.

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### **Installation Tips**

When installing lamps, it's recommended that they be located downstream of the coil to assure mold control. Also, they should be 90 degrees from the plane of the coil fins. This allows the light to uniformly penetrate the spaces between the fins and into the condensate pan.

As the coil is aluminum, it literally

Lamp life is a function of the application (number of starts per day), and the remaining output or intensity can only be measured with a radiometer. A radiometer is thus recommended as part of any professionally installed system. However, average lamp life is 7,000 hours and tubes can be changed on a predetermined schedule.

Confidence in the product's results

comes alive with photons to kill every organism in the cavity. Also, the location of the lamps downstream of the filter and coil prevents them from accumulating dirt. One other attractive feature is that due to their shape (5/8 inches diameter) and cross-sectional area, the lamps create little or no air flow resistance or turbulence.

When handling UVC lamps, it's necessary to wear protective gloves to avoid soiling the quartz glass surfaces. Cleaning kits containing gloves are available to keep lamps clean for maximum performance. Access to the lamps should be tied in with the hvac system's power so that the lamps go off anytime access to the system is made. This will prevent accidental or unnecessary exposure to UVC energy.

While there are no known long-term adverse effects from exposure to UVC, there are recommended limits. As ordinary glass and most plastics attenuate UVC, a standard full-face mask, gloves and clothing will provide protection if you need to work on an operating fixture.

has increased after learning that, in the past, conventional UVC lamps were used in static air applications for disinfecting surgical and dental instruments, barber supplies, baby bottles, drinking vessels and even bowling shoes. Through the mid-'50s, UVC lamps applications could be found in dairies, bakeries, breweries, wineries and bottling plants. Other uses included veterinary clinics, stables and pens, walk-in coolers and pharmaceutical houses.

In the mid-to-late '50s they played a part in the early eradication of TB in hospital surgical and emergency rooms, intensive and patient care rooms, and waiting and diagnostic rooms. They're still part of the Centers for Disease Control (CDC) recommendations for controlling TB and the National Safety Council recommendations for hvac mold control. (See sidebar for more product history.)

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## Countering New Problems

Allergies are increasingly associated with mold and mold products; and humidifier fever, hypersensitivity pneumonitis and Legionella are becoming more common. Cases of allergic asthma and rhinitis are on the rise - right in step with tighter buildings, fewer air changes per hour and an increase in the number of air conditioned

The recent advances in UVC production provide a tool for moving or still-air applications to 0° F and moving air applications to 140° F. In conjunction with duct cleaning, balancing, high-efficiency filters, humidity control and good housekeeping practices, these high output UVC devices provide an excellent means of preventing the growth of microbes in hvac systems.

spaces.

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# The Fall And Rise Of UVC

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**J**ohann Ritter Wilhelm (1776-1810)

and a contemporary, William Hyde Wollaston, are credited with discovering UV light energy. Niels Ryberg Finsen (1860-1904), a Danish physician, invented the Finsen Curative Lamp, which was used well into the 20th Century for treating bacterial infections of the skin.

In the 1870s, a Scottish physicist, James Clerk Maxwell, theorized that radio waves, microwaves, visible light, ultraviolet light, X-rays and gamma rays all travel at the speed of light through space in a wavelike motion. His work led to a greater understanding of these wave forms.

In the early '30s, Dr. Harvey Rentschler of Westinghouse was credited with commercializing the Sterilamp

Spaces were closed to outside air sources; workers were gowned, masked, and gloved; preservatives and antibacterial agents became commonplace; and antibiotics and other drug use increased. The market turned toward what were considered more economical and reliable methods of control, and UVC popularity declined.

Today E. coli, salmonella, measles, drug-resistant TB and other diseases have returned with strength in numbers. In the meantime, litigation over IAQ problems has become big business.

Filters alone can't provide complete control over biological contaminants. Furthermore, HEPA (high-efficiency particulate air) filters are expensive to install and maintain and are not practical for many existing hvac systems. Thanks to the latest engineering advances which allow high output of UVC energy in cold and moving air, UVC in modern spaces

UVC tube. All makers of fluorescent lamps eventually began making UV tubes, although today only a few custom-type devices remain. World War II increased the demand for UVC to preserve medicines and foodstuffs by irradiating both the goods and the packaging materials.

is again a viable tool.

The trend for using UVC ebbed, however, as filtered, mechanical ventilation came into use. The UVC lamps of that era (and conventional lamps today) only perform well in still air of 75° to 80° F.

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*(Please note that use of UVC for applications other than prevention of mold requires technical assistance from a qualified practitioner or from the UVC light manufacturer.)*

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