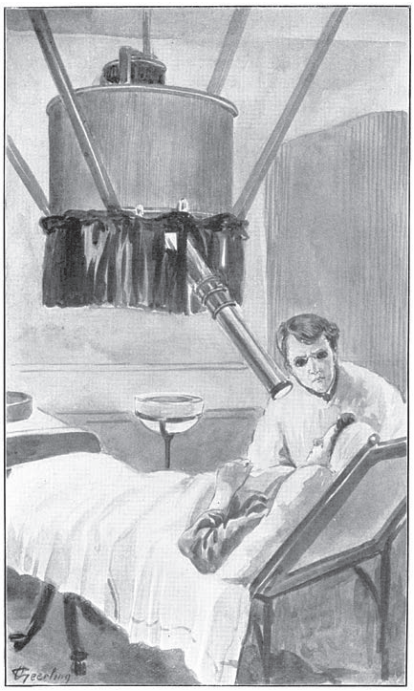
UV Lights:
Keep Your Air Handler Clean & Your Bottom Line Green!

By Chris Willette

What's all the hype about UV lights? You attend the tradeshows and read the latest trade journals and they are everywhere – should everyone use them or is it just a fad? Should you jump on the band wagon and capitalize on the hype or wait for the technology to prove itself?

The Facts:

For over a century scientists have known of the germ-killing power of ultraviolet light. In 1903 Dr. Niels Finsen won the Nobel Prize for his use of UV light for the treatment of tuberculosis. The technology has been used to control pathogens, from disinfecting water to controlling airborne diseases in hospitals. Today, more products are using germicidal UV lights as a tool for disinfection than ever before, from counter top water sterilizers to portable air purifiers. And over the past decade, UV technology has shown significant benefits in the HVAC arena and is rapidly growing in use.



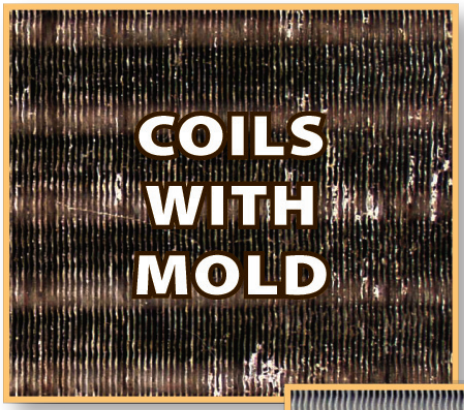
Dr. Nild Finsen using UV light to treat tubercilosis in 1903

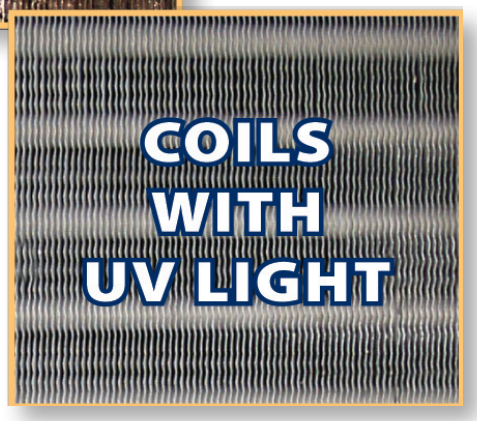
This growth in popularity has caught the interest of research institutes, government agencies, and trade groups which are investigating the effectiveness of ultraviolet light for indoor air applications. The results have been overwhelmingly positive and these organizations now recognize the benefits of the technology. These include the CDC, EPA and many others such as ASHRAE with their Chapter 16 addition in the 2008 Handbook on UVC systems and chapter 5.9 of the 2003 GSA Facilities and Standards for Public Building Services. The US Green Building Council also offers LEED points for certain applications of UV-C light in HVAC systems for improved indoor environmental quality.

What is Ultraviolet Light?

The light we can see is just a portion of the light spectrum. Low frequency Infrared light is invisible and is experienced as heat. Ultraviolet light is also invisible but has a higher frequency than visible light. The frequency of UV light is between 90-400nm. This is further broken down into three ranges. UV-A (320-400nm) is used for black lights and tanning beds. UV-B (280-320 nm) causes sunburn. The effective range for disinfection is UV-C (200-280 nm with peak germicidal effectiveness at 254nm). This is also referred to as UVGI light (which stands for ultraviolet germicidal

irradiation). UV-C light from the sun is filtered out by the Earth's atmosphere so microbes have no defense against it.





Exposure to UV light has a devastating effect on microorganisms. The very short wavelength of UV-C light penetrates the membrane and nucleus of microorganisms and breaks apart the molecular bonds of DNA. This inhibits the organism's ability to reproduce, effectively killing it. The amount of UV exposure needed to accomplish this varies from microbe to microbe. Spores, and some environmental bacteria tend to be more resistant and can survive relatively longer exposure than most viruses and other organic contaminates which cause odors.

How Can UV Technology Benefit My Facility?

It all comes down to the bottom line! UV light has been shown to save energy, reduce maintenance costs and extend the service life of equipment. The result can mean significant savings.

UV light systems are currently the best technology available to provide ongoing microbial growth control on air conditioning coils. When combined with energy and maintenance savings, a typical UV light system can pay for itself in as little as 6-12 months.

UV light is also provides enhanced indoor air quality which is reason enough to install one of these systems.

How Does UV Light Provide Energy Savings

The UV light system is typically placed downstream and facing HVAC coils and operated continuously. This placement helps to inhibit the growth of mold and bacteria on the coils that, if left unchecked, can accumulate and grow there, robbing the system of performance. By keeping the coils clean, the UV system will improve static pressure across the coil reducing the load on the blower and improving heat transfer which both contributes to significant energy savings. Studies have shown that a bio-film thickness of only .002" on the coil surfaces can reduce the free area and increase air velocity up to 9%. By rejuvenating the coils and maintaining greater heat transfer, this can result in an impressive 30% increase in cooling capacity when compared to a system with a dirty coil.

Simplified Maintenance & Longer Equipment Life

When UV lights are properly installed, they can virtually eliminate the need for coil, drain pan and plenum cleaning. This reduces employee and occupant exposure to the coil cleaning chemicals and biocides and provides more time for other HVAC maintenance tasks.

Plus, by keeping the coils clean, UV lights can dramatically increase the service life of a coil which otherwise would need to be replaced due to biofouling and blockage.

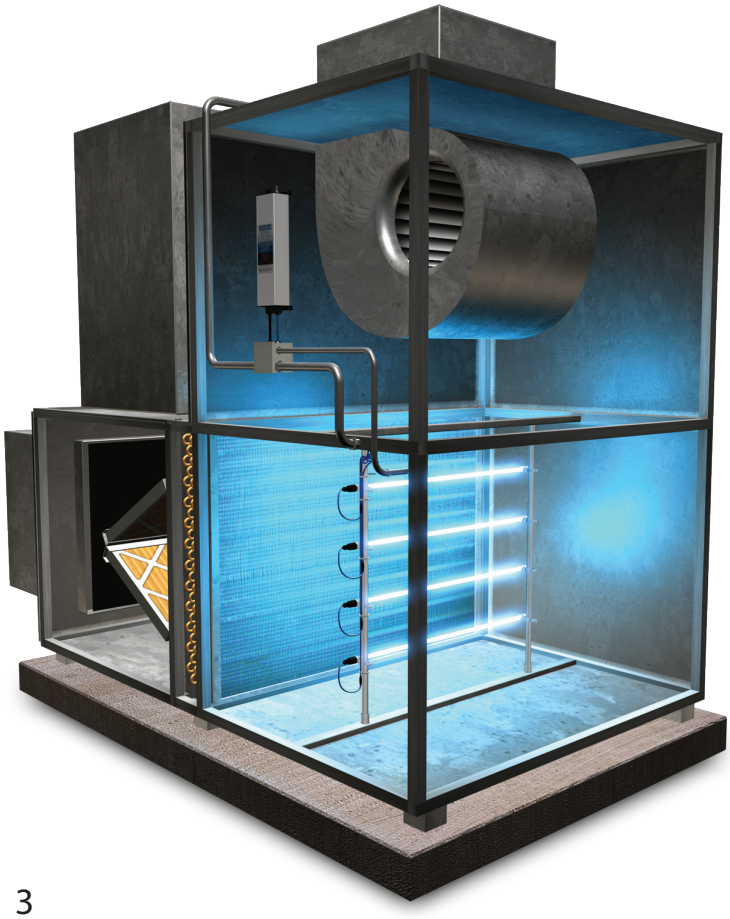
Improved Indoor Air Quality

By keeping HVAC system components clean and mold free, UV light systems have been shown to greatly improve indoor air quality. A well known study by the medical journal "Lancet" in 2003 showed that UV lights reduced microbial contamination within the HVAC system by greater than 99% and reduced occupant respiratory illnesses by more than 40%.

UV Light System Design and Placement

The ideal UV light system for use in air handlers is one that enables the UV lamp to be placed in the best location possible to provide the optimal use of the UV light energy and with the correct number of lamps to do the job effectively.

Calculating the number of lamps for optimum coil and surface exposure is critical. Over-sizing the UV system can waste energy while, under-sizing or poor placement can be ineffective. Most UV lamp manufacturers have simple methods of figuring the number of lamps required that is based on cooling coil dimensions.



Lamp placement and arrangement is equally critical. Placing the lamps in a horizontal arrangement for complete coil and surface coverage is typical. Mounting the lamps on a rack that allows 360 degree irradiation provides the most efficient use of the UV light energy.

The UV lamps are often placed on the downstream side of the coils, however this location is often the coldest and wettest location of the air handling system and can be harsh on electrical components and the power supply. A UV light system that has the lamps "detached" and remotely mounted from the power supply can overcome this. The best UV light systems are robust and are designed to withstand the cold, wet environment inside the air system. They feature waterproof wiring harnesses and connectors and lamps that can withstand the cold.

Lamp life and intensity are also important to consider when evaluating UV light systems. People often feel that "more is better" as when choosing a car with more horsepower. But when it comes to sizing a UV light system more is often not better. Higher intensity lamps can cause damage to internal air handler components and duct materials. And these lamps do not last as long as lower intensity models.

Recent studies have supported the idea that direct UV-C exposure can sterilize any surface given enough time. With that in mind, driving the UV lamps for more intensity is not necessary. Instead, operating them at optimum UV-C intensities for maximum lamp life is the preferred approach.

The power supply is a critical component to the optimum operation of a UV light system. With advancements in electronic power supplies in recent years, it is now possible to incorporate high frequency solid-state power supplies in UV light systems. These represent a big improvement over the magnetic types of years past. Features can be added into the power supply such as automatic voltage sensing for 120 thru 277 VAC, 50 or 60 Hz, short circuit and end of lamp life protection. Also, a power supply that can be remotely mounted from the UV lamps is also desirable as it will provide more flexible mounting options for the lamps and allow the power supply to be mounted virtually anywhere.

Safety Precautions

As with any electrical device, installing and servicing these devices should be performed by a trained professional. Power should be disconnected from the UV system before any work is performed. UV-C light like many other types of electro-magnetic radiation can be harmful to humans. Exposure can cause redness of the eyes or temporary blindness, so technicians should be trained in the dangers of working around UV light. In addition, safety features such as remote kill switches or panel safety switches should be incorporated to prevent accidental exposure. UV-C resistant viewports can be installed on the air handler to safely monitor UV lamp operation without harm. Because the effects of UV-C radiation are limited to the area that the light shines on (inside the air handler) there is no exposure risk at all for building occupants.

The Bottom Line

UV light for disinfection is a technology that offers great benefits at relatively low cost. It enables building engineers and HVAC technicians a means of controlling biological contamination without chemicals, extends the service life of air handling equipment, and improves indoor air quality for building occupants. This energy-saving technology is environmentally responsible and is likely to become an essential part of air handling systems in the twenty first century.

About The Author

Chris Willette is president of Triatomic Environmental Inc. located in Jupiter, Florida, which specializes in providing advanced germicidal UV light solutions for the enhancement of indoor air quality. Chris has been designing and developing products for the indoor air quality industry since 1994. He has published numerous articles and has several patents, and patents pending for UV-C light technologies.

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