Seeing Coil Cleaning In a New Light
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Ultraviolet technology gives managers options in keeping coils cleaner and more energy efficient

Ultraviolet (UV) technology is an increasingly common choice for maintenance and engineering managers looking for more effective means of cleaning cooling coils. The goal is to find methods that prevent indoor air quality (IAQ) problems and maximize coil performance.

A review of UV technology as it pertains to this type of application- cleaning coils and drain pans to prevent the growth of mold and bacteria - offers insights into the most appropriate situations for the use of UV technology, as well as any potential drawbacks to the use of the technology.

Components of light

Ultraviolet (UV) light is electromagnetic energy. Like sound, light is propagated in waves, and just as the human ear cannot hear some sound waves, the eye cannot see some light waves. The visible light spectrum goes through all the colors, from one end to the other, starting with red and ending with violet.

Invisible LTV is next to the violet end, so it is referred to as ultraviolet. UV light wavelengths are between those of x-rays and the color violet in the spectrum.

One unit of measure of light waves is the nanometer (nm). UV light and all other forms of electromagnetic radiation come in discrete energy packets called photons. The UV portion of the electromagnetic spectrum has wavelengths of 100-400 nni, and it is divided further into four ranges - UVA, UVB, UVC and VUV.

UVA has a wavelength range of 315-400 rim and causes suntan. UVB wavelength range is 280-315 nm and causes sunburn.

The UVC wavelength range is 200-380, and it can cause cancer and mutations. The UVC wavelength is most effective against many bacteria, fungi, mold and viruses.

Vacuum UV (VUV) has a wavelength range from 100200 nm. VUV is readily absorbed by water and air, so it can only be transmitted in a vacuum.

UV disinfection

The portion of the UV spectrum that contains the microbe hunters, which are important for the disinfection of water and air, is the range that is absorbed by DNA. This range is approximately 200-300 mn, with a peak germicidal effectiveness at about 260 nm. The mechanism involves LTV photon absorption by a pyrimidine base, such as thymine, where two pyrimidine bases are next to each other on the DNA chain. The reaction causes a linkage of the two bases, disrupting the DNA chain, so when cell division occurs during growth, DNA replication is inhibited.

This is a physical reaction, so nothing is added to the water, there is no danger of spills and no costly chemicals to buy. It is not possible to over-treat or under-treat with UV. It is a continuous process of retreating the water each time it circulates through the treatment header or channel, so bacteria, mold, fungi and viruses are kept at or below the target level.

Cooling applications

Chillers cool water or other fluids and circulate the cooled water through coils to the supply-air coils, where they absorb heat from the air. The warmed water, which is usually very dirty and has high oxygen content, is a perfect incubator for continuous microorganism growth. Toxic biocides and ozone often are used, sometimes intermittently and sometimes continuously to counteract and control microbe growth. A typical application of two to three times a week can help a facility maintain an acceptable organism growth rate.

A combination of 40-micron filtration and LTV in a side channel parallel to the mainstream also can hold down the growth rate to an acceptable level. It can even lower the rate achieved with biocides, in some cases, depending on the organisms' present.

The reason for the filtration before the UV treatment is to catch most of the particles that would otherwise settle out on the heat exchanger surfaces and reduce their heat transfer efficiency. Also, keeping the surfaces clean can reduce under-deposit corrosion.

It takes only a slight buildup of solids deposits or biofilm to substantially raise energy costs and labor related to tube-cleaning. Cooling tower pans and pump strainers will require less cleaning too.

The LJV system is made up of a treatment chamber through which the water flows. The UV source is low pressure mercury discharge lamps in a quartz filter envelope that allows only 254- or 185-nm wavelengths to pass. Disinfection systems use the 254-nm lamps that discharge energy into the stream as the water passes under the lamps. UV light penetrates the microbe and alters the DNA, destroying it in a physical process that does not require chemicals.

Benefits

Maintenance and engineering managers might consider the use of LN technology for several reasons. The technology:

- can be more cost-effective
- requires no licenses or permits and little training
- adds nothing to the water
- is continuous while the equipment is running automatically delivers the correct dose
- contributes to cleaner air
- requires maintenance only to periodically clean lamps and replace them about once a year.

A LTV equipment representative can analyze a system's requirements and perform a cost-benefit analysis. While this is site-specific due to the large number of variables present between sites, generally the demonstrable payback period is less than two years.

Additional applications

In addition to cooling-water treatment, LJV technology has many other appropriate applications. Water, air and effluents are being disinfected with UV technology. Some such applications include potable water treatment, air purification, metalworking coolant treatment replacing or reducing biocide use and cost and food processing.

One of the major areas where many large-scale installations have been built is for the treatment of drinking water and wastewater in many municipalities. Drinking-water UV treatment has grown rapidly. There are 50 plants in Europe that handle up to 40 million gallons per day. The trend is toward a sequenced multiple barrier approach using a combination of pre-oxidation, ozone, and filtration, followed by UV and finally chloramine.

Finally, another application called ultraviolet-germicidal irradiation has been found to be effective in reducing bacteria that causes tuberculosis in hospitals, shelters, jails and prisons where the population can carry the disease undetected.

A customized system for a facility's needs using the latest UV technology can reduce costs, can be more reliable and can make a major contribution to cleaner air and water.

UV Technology: A Case Study

Among the most popular applications of ultraviolet (UV) technology is taking place in wastewater treatment facilities. For example, officials at a San Francisco area municipal wastewater treatment plant that handles 40 million gallons of wastewater per day recently replaced a 20-year-old chemical treatment system with a new UV system.

The previous system used a combination of 3,5 00 pounds of chlorine and 2,400 pounds of sulfur dioxide per day. The sulfur dioxide was required to neutralize the chlorine. In the 1990s, Clean Air Act rule changes limited worker exposure to chlorine and enacted double-containment legislation to reduce the potential for spills. Plant officials also were concerned that chlorine leaks in the area could expose the general population to potential harm or that handling mishaps could injure workers.

Management obtained annual cost comparisons of three other approaches - UV, hypochlorite and ozone, and they found that the cost of UV was comparable to chlorination- dichlorination. Hypochlorite was two times the cost of UV, while ozone's annual cost was more than twice the cost of UV.

The utility built a pilot plant capable of handling 1 million gallons of water a day, and it demonstrated that UV killed bacteria as well as chlorination, and it killed viruses better. The utility then built a full-scale plant at which water is piped into a treatment channel consisting of 18 banks of 400 low-pressure mercury UV lamps in each bank. The channel is covered with clear plastic to control algae. Energy requirements total 700 kW, or about 75 watts for each lamp. A 7-megawatt gas-fired power generator was included in the system for emergency backup. The 9-ton banks are raised for cleaning with 2 percent citric acid every two to four weeks to maintain energy efficiency and peak bacteria and virus removal rates. Lamps have about a one-year life.

So far, wastewater plants up to 225 million gallons a day are successfully using UV technology.

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