By Adam Donnellan, Sunlight Systems

COMMERCIAL, INDUSTRIAL ULTRAVIOLET SYSTEMS

Available technologies and their use in C&I applications

In past articles, we discussed the benefits of ultraviolet (UV) disinfection as well as the many available options. In this article, we will focus on the available technologies and provide an overview of how these technologies are being applied in commercial and industrial applications.

For the last 50 years, the majority of UV systems have incorporated what is known as low-pressure standard output lamp technology.

Using this technology, a single 30-inch lamp, which is 40 watts, can provide the average homeowner with a year's worth of protection for pennies per day.

Advances in the technology have provided UV manufacturers with more powerful lamps, which in turn has provided their clients with more options. While most of these may not be appropriate for the typical residential installation, they do provide benefits for larger commercial, industrial and municipal applications.

Latest Technologies

Low-pressure, high-output lamps provide two times the output of standard lamps. This technology can be used to reduce the number of lamps needed or it can be used to provide much higher UV doses to the process water.

The difference between high output and standard output is the operating current and the fact that it is dependent on water temperature. While there are up sides to this technology, you will see an increase in operating costs as well as a loss of effectiveness in UV output at higher temperatures.

With energy costs now at the forefront, it is important to understand how this will impact your client's budget.

Amalgam lamps are approximately three to four times as powerful as standard output lamps. These lamps are being used primarily in larger flow systems as well as in wastewater treatment applications.

The differences between amalgam and the other lamp types is that amalgam runs on a higher current and also uses indium with the mercury. This technology provides some exciting prospects because unlike high output lamps, it is not dependent on temperature.

Table 1. Types of UV Bulbs

Type	Size	Watts	UV Watts @ 254nm
Standard output	30″	40	14
High output	30″	84	27
Amalgam	30″	160	55
Medium pressure	30″	2,000	varies

Medium pressure lamps are many times as powerful. A 30-inch lamp can be almost 50 times as powerful as the standard output lamp. However, unlike low pressure lamps that produce the majority of UV in the 254 nanometer range, these lamps produce UV from 200 to 700 nanometers.

These inefficiencies make the technology only appropriate for large flows or for applications where space savings is the primary concern. This is because a single lamp can treat 500,000 gallons per day.

When attempting to figure out the costs for power use the following formula.

$$\frac{\text{Lamp Watts} \times \text{Number of Lamps}}{1{,}000} = \text{Kilowatt Hour}$$

$$\text{kW Hour} \times 8{,}766 \text{ (hours in year)} = \text{Yearly kW}$$

Multiply Yearly kW by power cost per kW hour to get yearly power cost.

Applications

Most UV applications involve using the technology for germicidal disinfection. This is where water is exposed to the UV and the microorganisms are rendered harmless. While this is the primary use, UV systems are being utilized to remove organics (TOC reduction), destroy ozone, remove chlorine and aid many research and development projects.

Total organic carbon (TOC) reduction is accomplished through the use of ozone-producing UV lamps. These lamps produce UV light in the 185-nanometer range. This wavelength breaks down the carbon compounds and converts them to CO_2. TOC systems generally are used in the electronics industry where organic free water is necessary for washing components.

When designing a system, engineers generally build systems three to four times the size of a typical germicidal disinfection unit. A standard system will be designed to provide more than 150,000 microwatts.

Ozone destruction is accomplished through the use of 254-nanometer lamps. Using high doses, these systems are able to take the ozone out of the water supply. These systems are used in manufacturing applications where an ozone generating system or TOC UV system is being utilized.

When building this type of system, engineers will need to know the ozone levels. To remove .5 parts per million (ppm), the system will need to provide 90,000 microwatts. For larger concentrations (1 ppm), the system may need more than 150,000 microwatts.

Chlorine destruction is accomplished through the use of 254-nanometer lamp technology. End users are incorporating these systems as a means of reducing the chlorine in processes that utilize municipal water. These systems generally are being used to extend the life of carbon beds. It has been proven that high UV doses reduce the amount of chlorine in the system.

To accomplish this task, the system may have to be sized to more than 500,000 microwatts. When selecting this technology, the energy costs associated must be considered.

Research and development. Scientists are finding additional applications where UV light is beneficial. Projects ranging from treating gases to chemicals are being explored. For these projects, UV lamps are being custom designed to provide different wavelengths.

Conclusion

As the technology evolves, new uses are being found for this established and reliable technology. By balancing your needs with the appropriate technology, the solution will become clear.

The final installment of the UV series will appear in the July issue.

Designing a UV System

The following are some questions to consider when designing a UV system.

- What UV dosage is required?
- How many lamps does the system have?
- What are the anticipated operating costs?
- What is the most energy efficient system?
- What is the water temperature?
- What is the available power?
- What is the available space?
- What is the water makeup?

About the Author
Adam Donnellan is vice president of sales for Sunlight Systems. He represents the third generation of his family to be involved with UV water disinfection. He can be reached at adam@sunlightsystems.com.

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