By Adam Donnellan, Sunlight Systems

BASIC ESSENTIALS

Understanding Ultraviolet Terminology

The benefits of ultraviolet (UV) light in destroying waterborne diseases are well established. This article (part one in a continuing series) will focus on explaining the basic terminology associated with the technology. Table 1 provides a glossary of terms for your reference. Articles in upcoming issues will focus on designing the proper system, uses for UV technology, available UV lamp technologies and a case study of a drinking water installation.

Ultraviolet Disinfection

Microorganisms naturally exist on most surfaces exposed to air including water.

Tradgedies such as the Walkerton *E.Coli* outbreak that lead to a number of deaths remind us that even "safe" water supplies can be compromised. This is because floods and other unforeseen occurrences can introduce contaminants into the water supply. The most dangerous of these come in the form of human and animal wastes. With ever expanding population growth and the heavy competition for existing water sources, the World Health Organization has voiced its growing concerns about the potential of major epidemics associated with contaminated water sources.

UV disinfection is now at the forefront in providing a safe and economical option for treating drinking water and wastewater.

In the early 1900s, it was discovered that UV light has the ability to destroy disease-carrying microbes called pathogens. There are different types of UV light found in the electromagnetic spectrum. UV-C, known as short wave,is the type used for water disinfection. UV-C can be found in the range between 200 to 295 nanometers (nm). You are likely to hear the "254 nm" wavelength associated with germicidal disinfection.

Since not all microorganisms are created equal, it takes different doses of UV energy to render them harmless.

UV-C light is a successful treatment method because it can penetrate a cell's wall and cause massive damage.

To refresh your high school biology memory, a basic cell is composed of a cell wall, cytoplasmic membrane and nucleic acid (DNA). UV light targets the DNA, the very life center of a cell. Exposure to even low doses of UV light scrambles the DNA, which prevents reproduction. This inability to reproduce renders the microbe harmless and, for all intents and purposes, "dead."

Since not all microorganisms are created equal, it takes different doses of UV energy to render them harmless. The intensity of UV energy is expressed by the term "microwatt seconds per centimeter squared" or "microwatts."

In the 1960s, the Department of Public Health established the required energy level to be a minimum of 16,000 microwatts. Most of today's systems produce more than 30,000 microwatts and the industry is expecting some more stringent guidelines for design. This dosage is calculated by taking lamp strength and exposure time and plugging them into the formula below.

This formula provides the dose that a microorganism will receive as it travels through a purification device. It should be noted that transmission quality, the presence of solids and water temperature can interfere in the delivery of proper UV dosing.

Table 2 indicates the UV dose needed to provide 99.9 percent destruction of some common pathogens.

Once it is determined that UV disinfection would be a beneficial treatment option, it is then appropriate to design a system and configure it with the appropriate options.

The article next month will analyze the available options and provide advice on when to use them.

Table 1. Terms Associated with UV Disinfection

185 NM	UV wavelength associated with TOC reduction
254 NM	UV wavelength associated with germicidal disinfection
UVA	Naturally occurring from the sun
UVB	Used in the tanning industry
UVC	Used for disinfection
DNA	Deoxyribonucleic acid – target of UV light
Germicidal	Destruction of microorganisms
Pathogen	Disease causing microorganism (*E.Coli,* hepatitis,cholera)
Microorganism	Bacteria, virus, protozoa, algae, yeast, mold and other microbes
Microwatt	Expressed as uws/cm² – representing UV lamp intensity
Nanometer	One billionth of a meter
Wavelength	Distance measurement used to express type of UV

Table 2. UV Dosages for 99.9% Destruction of Common Pathogens

MICROORGANISM	DOSAGE (in microwatts)	TYPE
Fecal coliform	6,600	BACTERIA
Bacteriophage (*E.Coli*)	6,500	VIRUS
Vibro commo (cholera)	6,500	BACTERIA
Influenza	6,600	VIRUS
Hepatitis	8,000	VIRUS

Formula for Dosage Calculation

Intensity (microwatts) × exposure time (seconds) = Microwatt Dose Area (cm²)

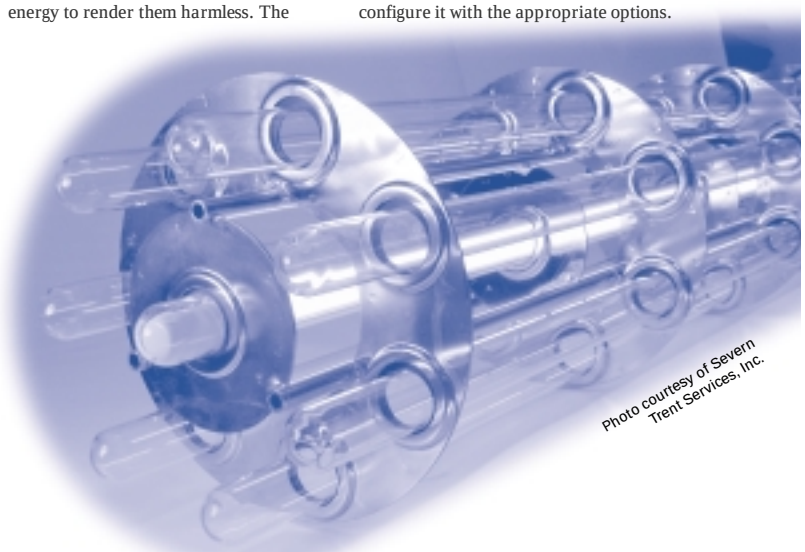

Photo courtesy of Severn Trent Services, Inc.

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