UV Light — A Brighter Disinfection Alternative

UV technology advancements, including high-output lamps and automatic chemical/mechanical sleeve cleaning systems, make it cost-effective to disinfect challenging effluents without the risks associated with chemical disinfection.

BY ROB JANSEN, KENNY KHOO, AND REGAN THOMPSON

Through many decades of research and development, UV (ultraviolet) disinfection technology has seen significant advances in the types of water that can be treated, the operation and maintenance of the UV equipment, and the overall cost-effectiveness of a UV system.

Approximately 25% of the wastewater treatment plants in North America currently use UV for disinfection. Although UV's primary use in North America has been for wastewater, many drinking water facilities are also installing UV in order to meet the U.S. Environmental Protection Agency's Long Term 2 Enhanced Surface Water Treatment Rule to protect water supplies from Cryptosporidium — a chlorine-resistant organism that is easily treated with low doses of UV.

Non-Chemical Approach To Disinfection

UV light is a form of light invisible to the human eye. UV light at wavelengths between 200 nm and 300 nm (billionths of a meter) are categorized as germicidal — meaning they are capable of inactivating microorganisms, such as bacteria, viruses, and protozoa. This capability has allowed the widespread adoption of UV disinfection as an environmentally friendly, chemical-free, and highly effective way to disinfect and safeguard water against harmful microorganisms.

Unlike chemical approaches to water disinfection, UV light provides rapid, effective inactivation of microorganisms through a physical process. The retention time required to achieve disinfection ranges from fractions of a second to a few seconds. This eliminates the need for a chlorine contact chamber, thereby reducing the required footprint and cost of installation.

When designing and sizing a UV system for an application, several water quality parameters must be considered such as peak flow, average flow, UV transmittance (UVT), and total suspended solids (for wastewater). UVT is the amount of UV light that is able to penetrate the water. The upstream treatment processes play a major role in determining the UVT value. Primary wastewater plants, for example, would have higher total suspended solids and a lower UVT value. Plants with lower UVT are still able to use UV but typically require more equipment or more powerful lamps.

Less Maintenance Through Innovation

UV disinfection technology has evolved immensely from earlier generations of systems. Operation and maintenance requirements have significantly reduced. Advancements such as increased lamp output, extended lamp life, automatic chemical/mechanical sleeve cleaning systems, automated dose/flow pacing, and Supervisory Control and Data Acquisition integration make today's UV systems easy to operate and maintain.

Lower Life Cycle Cost

The cost of retrofitting an existing chlorination system to UV is a common evaluation. The capital cost of a UV system is higher than a typical sodium hypochlorite system. Fortunately, the operating cost of a typical UV system is significantly lower than a hypochlorite system due to the increasing cost of chemicals. The retrofit of an existing hypochlorite system to UV has a high

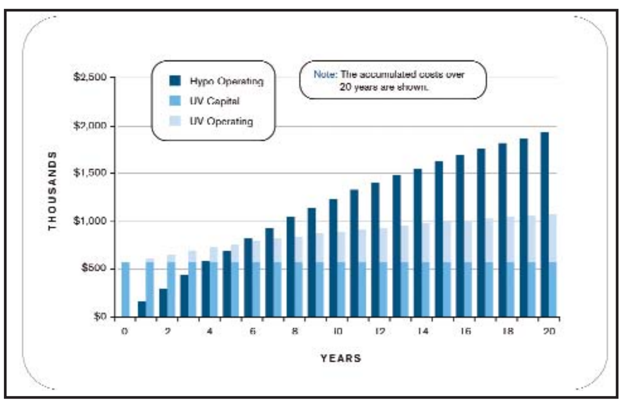

Figure 1: This graph represents the accumulated net-present value cost of UV and sodium hypochlorite for an actual wastewater treatment plant in New Jersey. Over the long term, UV becomes the more cost-effective solution at this plant.

initial capital cost, but over a span of a few years, the cost of the UV system would provide a return on investment. This payback is illustrated in Figure 1, since the cost of electricity and replacement lamps are lower than the cost of purchasing hypochlorite and associated dechlorination chemicals. Plants can also benefit from the nonmonetary benefits of a UV system such as increased operator safety and the use of UV as a public relations tool to emphasize the plant's use of "green" technology.

An Inherently Green Technology

The term "carbon footprint" is now common in today's vocabulary. Carbon footprint refers to the amount of carbon dioxide released into the environment by a given process or technology. An evaluation of chlorination and UV disinfection processes in a Life Cycle Assessment (LCA) can be performed to determine the environmental impact of each technology. In a LCA, various environmental impacts are taken into account such as ozone depletion, global warming potential (carbon footprint), acidification, eutrophication, ecotoxicity, human health effects, resource depletion, and land use. When the data are normalized based on the population of a given city, the results can be compared between various disinfection processes. UV has the least environmental impact since the biggest contributor to environmental impact is the transportation of chemicals due to the burning of fossil fuels.

A Bright Future

The advancements in the UV industry have benefited municipalities through the application of UV in challenging effluents, reduction in maintenance requirements, and implementation of a cost-effective disinfection solution. The installation of UV in communities has allowed operators to leverage UV as an effective public relations tool to educate the public on how water is treated in an environmentally friendly way. ■

Kenny Khoo is a Biochemical and Environmental Engineering graduate from the University of Western Ontario and is currently the Municipal Market Specialist at Trojan Technologies. He specializes in municipal wastewater and drinking water UV projects that have to meet requirements outlined in the NWRI UV Guidelines (2003) and the USEPA UV Guidance Manual (2006).

Rob Jansen works for Trojan Technologies in a Business Development role and has over 16 years experience in the Municipal Wastewater industry operating and managing Wastewater Treatment facilities.

Reagon Thompson is a Graduate of Georgian College Business and Sir Sandford Fleming Ecosystem Managment. He spent time working in the Environmental Analytical Laboratory Industry and currently is a Market Development Analyst for Trojan Technologies. www.trojanuv.com