UV Disinfection Knowledge Base

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Ultraviolet (UV) disinfection has been used in drinking water in Europe since the 1950s and wastewaters in North America for nearly two decades. While this track record suggests UV disinfection is an established technology, the practice of UV disinfection in drinking water has evolved considerably over the last decade. Research in the late 1990s demonstrated UV inactivation of Cryptosporidium and Giardia at very low doses, resulting in approval of the technology to achieve Cryptosporidium, Giardia, and virus credits under the U.S. Environmental Protection Agency (EPA) Long Term 2 Enhanced Surface Water Treatment Rule. This regulatory acceptance has resulted in increased implementation of UV disinfection throughout North America. Surface water treatment plants in the United States and Canada have installed UV disinfection for applications ranging from 0.5 to 2,200 million gallons per day (mgd).

Recognizing the opportunities for UV disinfection, manufacturers have developed new drinking water technologies. Advances including mercury amalgam and low pressure high-output (LPHO) UV lamps, high-power medium-pressure (MP) UV lamps, physical-chemical cleaning systems, UV sensors systems, UV dose monitoring systems, UV dose-pacing algorithms, have resulted in development of UV reactors capable of treating flow rates greater than 50 mgd. Other improvements to the science and practice of UV disinfection include new UV dose modeling approaches based on validation testing and computational fluid dynamics (CFD). Advances in regulations include the development of UV validation protocols and test facilities, as well as the development of EPA's UV Disinfection Guidance Manual (UVDGM) for design and operation of drinking water UV disinfection systems.

WRF Project 3117

As is the case with any rapidly evolving water treatment technology, utilities, engineers, and state regulators have questions and concerns with UV disinfection. The Water Research Foundation (WaterRF) saw a need to document industry practices and to fill important gaps in available information that limits how utilities, engineers, and regulators implement and operate UV disinfection technologies. Filling in these data gaps will significantly reduce the risks and costs of applying UV disinfection. Thus, the Water Research Foundation funded Project 3117 that was designed to answer these questions by developing a UV Disinfection Knowledge Base. The document, which is available at http://www.waterrf.org/Pages/Projects.aspx?PID=3117, was developed using a survey based approach that sought to:

• Identify issues and questions with drinking water UV disinfection from participating utilities, regula-

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To consolidate industry knowledge on drinking water UV disinfection

tors, and consultants
- Collect and analyze UV system data through surveys of participating utilities and field evaluations of installed systems
- Conduct an evaluation of mercury release with the breakage on LPHO and MP lamps and develop engineering approaches for mitigating mercury release

The final document, which includes survey data collected during the spring of 2008, indicates that 161 utilities in Canada and 148 in the US have installed or are implementing drinking water UV disinfection at plant flows greater than 0.5 mgd. There is more specific information on the systems surveyed including:
- Who is implementing UV and what types of systems are they installing
- What are the UV treatment objectives (see Figure 1)
- UV system design criteria
- Installation configurations

- Performance of UV system components
- Replacement costs for UV system components
- UV system operation and maintenance
- Lessons learned and recommendations

Summary

The resulting document was authored by a team of industry experts including:

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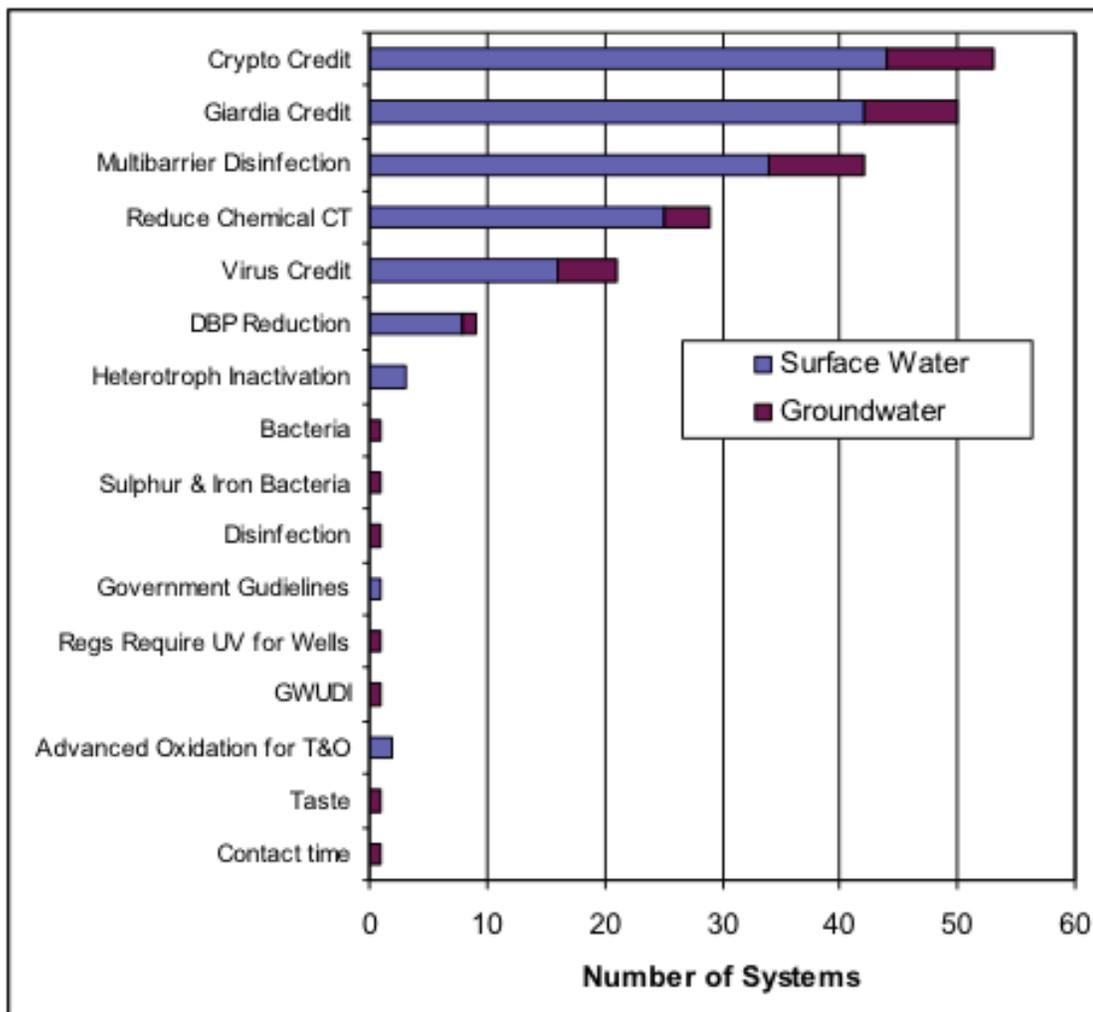City of Boise, Idaho

The document is a culmination of industry data and information collected through the WRF Project 3117 survey that reports on the comprehensive experience of UV disinfection at water treatment plants in the U.S. and Canada, provides numerous recommendations for utilities planning to implement UV disinfection and those already operating UV systems, and serves as an invaluable tool for utilities, regulators, design engineers, operations staff and others.

Figure 1. Survey results for UV treatment objectives