

## Reassessment of UV Validation Factors Required to Reflect New Information

A wide range of UV drinking water disinfection systems offer cost-effective compliance alternatives for the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and Ground Water Rule (GWR). The U.S. EPA *UV Disinfection Guidance Manual* (UVDGM) is currently the accepted technical reference for validating and designing UV disinfection systems for drinking water treatment.

Technological innovation has advanced the science of UV inactivation since 2006. The UV equipment available today includes disinfection systems with stronger and more energy efficient lamps, synthetic quartz sleeves that allow more UV energy to penetrate the water column, and units that are based on much greater experience in

- full-scale validation testing,
- modeling of system performance, and
- system operation in the field.

### Emerging Issue

As UV technology advances, engineers, academicians, validators and UV manufacturers are reviewing accepted assumptions, models and methodologies. Recent validation testing and computational fluid dynamics (CFD) modeling raises the possibility that the validation process used by some medium pressure UV systems may not account for disinfection from low wavelength (i.e., less than 240 nm) UV light. The discrepancy is between the dose proven in full-scale testing with surrogate organisms and the level necessary for targeted organisms (e.g., *Cryptosporidium*). Some surrogates (e.g., MS2 phage) are inactivated more easily than target pathogens (e.g., *Cryptosporidium*) by the light in the low-wavelength UV spectra.

This development is important to both current and future design and operation of medium-pressure UV systems. Low-pressure and low-pressure, high-output UV disinfection systems are not impacted.

Depending on the validation testing approach and implementation at the water treatment plant, the contribution of low wavelength UV light may suggest better *Cryptosporidium* inactivation (e.g., when MS-2 phage is used for validation testing) than is actually occurring. For example, if a medium pressure lamp provides 30% of its disinfection power using wavelengths below 240 nm to achieve a validated dose of 5.8mJ/cm<sup>2</sup> (LT2ESWTR required dose for two-log *Cryptosporidium* inactivation), the remaining 70% might not be enough to provide a full two-log reduction of *Cryptosporidium*. Calculating the impact of this new data on any disinfection system requires considering a number of factors including the:

- spectrum of UV light entering the water column,
- length of water column through which UV light passes,
- spectral absorbance of the test waters used during validation, and
- action spectra of both the validation challenge and target organism(s) to be disinfected at a water treatment plant.

Analysis is ongoing to account for these factors. It appears that some medium-pressure UV systems will need to increase the minimum UV dose to ensure that targeted inactivation levels are being achieved under the full range of potential operating conditions.

### Process to Resolve

Technical experts, including academicians, water utilities, consulting engineers, manufacturers, and validators, met Sept. 23, 2011, to share information and better understand this issue. The group members represent much of the same expertise used to develop the 2006 UVDGM. With five more years of experience designing, validating, and operating UV disinfection systems, the group began evaluating the low-wavelength effect in both existing and new medium-pressure UV disinfection system installations. The group's

goal is to develop an interim solution for existing medium-pressure UV facilities and a more detailed protocol to assure appropriate inactivation levels are achieved by current and future medium-pressure UV disinfection systems.

### **Timeline**

Using a consensus approach, the workgroup has made good progress identifying the key factors and engaging experts with needed expertise. How quickly a protocol will be developed remains to be seen. Progress will be assessed on Nov. 14, 2011, in a meeting at the American Water Works Association's (AWWA's) Water Quality Technology Conference in Phoenix, Ariz.

### **Communication and Outreach**

The process of crafting a robust protocol requires both technical dialogue and testing. Drinking water professionals interested in this topic can stay abreast of developments in several ways:

- Attend an open meeting of the workgroup, Monday, Nov. 14, from 7-9 a.m., at AWWA's Water Quality Technology Conference (Room 126A of the Phoenix Convention Center).
- Information will be distributed via the following list serve: <http://iuva.org/newsletter-signup>
- Watch for articles in AWWA and IUVA publications.

### **Summary**

Medium-pressure UV disinfection systems provide robust and reliable disinfection of potable water. The LT2ESWTR and UVDGM incorporate significant levels of conservatism to assure reliable inactivation is achieved once medium-pressure UV disinfection systems are installed. A new effort has begun to develop an approach to assess validation data and -- when necessary -- adjust system operation to ensure medium-pressure UV equipment achieves inactivation levels that meet LT2ESWTR requirements.