By Melissa Lubitz

UV DISINFECTION

ENTERING THE CANADIAN AND U.S. DRINKING WATER REGULATIONS

Although Ultraviolet (UV) disinfection has been proven time and time again to be extremely effective for the primary disinfection of drinking water, it is only within the last year that drinking water guidelines, across both Canada and the United States, have incorporated UV into their standards as an acceptable means of disinfection. These guidelines include both residential and municipal applications.

Both Canada and the United States hold Federal Guidelines for drinking water; however, these guidelines are applied differently in each country for each individual state or province. The U.S. Environmental Protection Agency (EPA) has the National Primary Drinking Water Regulations, as mandated by the Safe Drinking Water Act, which is applicable to all states and some U.S. territories. In order to obtain primacy, each state must have an approved regulation that is at least as stringent as the federal regulations if not more so. Health Canada is responsible for researching all health risk assessments associated with the ingestion of specific parameters in drinking water as well as recommending guidelines with regards to different microbiological and chemical parameters in drinking water. Each province and territory is responsible for providing safe drinking water as well as implementing their own guidelines. The Federal-Provincial Subcommittee on drinking water must then evaluate and approve these guidelines for each individual province.

Canada

In Canada, the municipalities within each province usually oversee the day-to-day operations of drinking water treatment facilities. It has been found that although some Canadian provinces do not maintain drinking water regulations that specify UV for primary disinfection, the majority of them will accept it if the UV manufacturer can provide performance data and some type of third party validation. These provinces also require the design of UV facilities to follow a specific standard, referred to as the Ten State Standard. This technical standard is also referred to in the United States.

To date, the only province in Canada that has outlined the application of UV disinfection within their drinking water guidelines is Ontario. Ontario's Drinking Water regulations were amended in June 2003 and are now entitled Regulation 170/03, it was formally known as REG 459 and REG 505. A few of the Canadian provinces, like Manitoba, Alberta and British Columbia, have indicated that they will adopt EPA Drinking Water Guidelines for water treatment and UV application once the EPA has finalized their guidelines.

Ontario operates a site-specific permit system for municipal water supply plants, which falls under Schedule I in REG 170/03(municipal large residential and municipal small residential systems). Other types of facilities are also being regulated through engineering processes and inspections if they have their own water supply. This would include facilities like retirement homes/communities, schools, hotels, resorts and campgrounds, which fall under Schedule II (municipal non-residential, non-municipal residential, non-municipal non-residential). Depending on the category each water supply falls under will determine when they have to comply with the new regulations. According to the Ontario Drinking Water Regulation 170/03, if UV equipment is provided by a drinking water system, the owner of the system and the operating authority for the system shall ensure that the following are met:

- The disinfection equipment must have a feature that causes an alarm to sound, in the building where the disinfection equipment is installed or at a location where a person is present (if there is not always a person available in the structure where the disinfection equipment is installed), if the equipment malfunctions, loses power or ceases to provide the appropriate level of disinfection; and
- If the alarm sounds a certified operator must take appropriate action as soon as possible.

Drinking water guidelines, concerning UV as a primary disinfectant, can be found within the "Procedure for Disinfection for Drinking Water in Ontario," which was released in March of 2003. Within this document, under Section 3.2, the UV requirements are outlined. This section states that UV application is

acceptable only if the system in question has shown to achieve the required level of disinfection through reactor biodosimetry testing using MS-2 bacteriophage to establish flow/transmission maxima. In general terms, only a UV system that has third party validation, which provides the appropriate information with regards to the required UV dose level, can be applied under this regulation. UV is only acceptable if the water is receiving a 40 mJ/cm^2 dose at the end of one year (end of lamp life). All disinfection treatment systems using UV as the primary disinfectant must incorporate a chlorine residual throughout any kind of distribution system that it may have.

LT2ESWTR

The EPA released an amendment to the Drinking Water regulations in June of 2003. This was entitled the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The LT2ESWTR requires Public Water Systems that use surface water or groundwater under the direct influence of surface water monitor their source water for *Cryptosporidium*, *E. coli* and turbidity for a limited period. UV disinfection was incorporated in these amended regulations as an alternative to chlorine as a primary disinfectant. Therefore, under the EPA new drinking water regulations the Disinfection Guidance Manual (DGM) draft was developed. The DGM is currently in draft form and is speculated to be promulgated in the fall of 2005. The draft manual provides guidance on the selection, design and operation of a UV disinfection system in order to comply with the EPA drinking water regulations. The DGM draft also outlines the required specifications for delivered UV dose, reactor validation, and reactor monitoring. The UV dose specifications are described in the draft as inactivation credits, which can be defined as increasing levels of disinfection. Not all water treatment systems require the same level of disinfection as the water source and the contaminants it contains will vary. The higher the inactivation credit, the larger the delivered dose from the UV system. For example, if a 3-log inactivation credit is specified for both *Cryptosporidium* and *Giardia*, for a given water supply, the DGM draft gives a dose of 36 mJ/cm^2 and 34 mJ/cm^2 in order to accomplish this level of inactivation. The dose values outlined in the DGM, for these protozoan cysts, are a great deal higher than the dose levels that have been found in multiple research studies. This can be seen in Table 1.4.

As you can see from Table 1.4 of the DGM draft, dose levels of almost one

TABLE 1.4 UV DOSE REQUIREMENTS USED DURING VALIDATION TESTING[1]

	LOG INACTIVATION							
	0.5	1	1.5	2	2.5	3	3.5	4
Cryptosporidium	1.6	2.5	3.9	5.8	8.5	12		
Giardia	1.5	2.1	3	5.2	7.7	11		
Virus	39	58	79	100	121	143	163	186

[1]40 CFR 141.729(d)

third are actually required for a 99.9 percent (3-log) inactivation. The reason for the higher dose values is to incorporate all possible safety factors (sleeve fouling, sensor and lamp uncertainties, etc.) into the microorganism inactivation. The same applies for all virus inactivation credits.

Drinking Water Guidelines

The Canadian/Ontario and U.S. drinking water guidelines apply to both municipal and small facility applications; however, the UV system required for each type of application will differ due to the change in volume of water that will need to be treated. Smaller facilities applications can range in water volume from 30–100 gpm, depending on what type and how large a facility it is (school, campground, etc.). Regardless of the volume of water, any type of UV system that is to be incorporated into the primary disinfection of drinking water must have proof of it's capability to disinfectant. Proof of a UV system's capability is a requirement of both the Canadian and U.S. Drinking Water Guidelines.

Third Party Validation

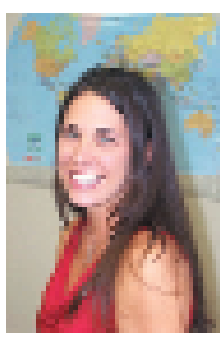
Third party validation or biodosimetry testing is possible for any sized UV system. Validations can vary depending on the third party and validation facility used, the protocol followed and the parameters tested during the validation. In the U.S., NSF International has developed a standard for the testing/validation of UV equipment—NSF 55 Class A. According to the standard, a Class A system shall deliver a UV dose at least equivalent to 40 mJ/cm^2 at the alarm set point when the system is tested in accordance with 6.3.2.7 or 6.3.2.8 as applicable. UV equipment validated under this standard can be used in smaller drinking water applications as this standard is strictly for UV systems installed in some type of facility. All systems validated under NSF 55 are referred to as point-of-entry (POE) or point-of-use (POU) systems. According to NSF/ANSI 55 standard, POE systems are used to treat all or part of the water for the facility at the point where drinking water comes into the facility, for Class A systems, a single-family dwelling shall be considered a facility; POU systems are used to treat water at a single tap or multi-taps but not for the entire facility. During the validation NSF acts as the third party expert, the validation facility as well as the recognized laboratory to analyze the water samples collected. When validating under the NSF 55 standard, the bioassay lab has a maximum flow rate capacity of 40 gpm up to 100 psi, and can run the maximum flow rate test up to 150 psi at 30 gpm. Because the majority of residential UV systems have a maximum pressure rating of at least 125 psi, a UV system outside of those flow rate/operating pressure conditions must be validated by another facility.

Because NSF follows a specific protocol for the validation of UV systems, other protocols do exist and will vary depending on the type of information needed with regards to the system in question. This can include lamp aging data, UV sensor uncertainties, or different levels of UV dose depending on changing conditions. A UV manufacturer can develop their own validation protocol or follow an existing one. Many different validation protocols are available ranging from the Austrian protocol entitled ONÖRM M5873-1, the German DVGW W294 protocol, EPA/NSF ETV protocols, the protocol options outlined in the new EPA DGM, or any protocol that is determined by the UV manufacturer. All validation protocols are not the same and should be analyzed in great detail. In order to put these testing protocols into play there are several UV validation facilities that can conduct the validations for UV systems, ranging from moderate to very high flow rates. These validation facilities will oversee all aspects necessary to complete the approved system validation and will follow the protocol that the manufacturer has specifically chosen. Depending on the facility the flow rates that each is capable of reaching can vary. There are validation facilities that can accommodate up to 40 mgd. UV manufacturers also have the option of finding their own water supply, hiring a UV expert as their independent third party who oversees the validation and using a recognized microbiological laboratory to test their water samples.

In comparing both the Ontario and U.S. drinking water regulations, with regards to UV as a primary disinfectant, you can see that regulations are pushing for the same final outcome: Incorporate UV disinfection as an alternative disinfectant however ensure that it is effective, if not more so, than it's predecessor chlorine.

More information on the Ontario and U.S. EPA drinking water regulations can be found at www.ene.gov.on.ca, www.epa.gov/safewater/lt2/guides.html. WQP

For a complete reference list go to www.wqpmag.com/lm.cfm/wq100401



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