CIWEM Chartered Institution of Water and Environmental Management

Policy Position Statement

Ultraviolet (UV) Disinfection of Drinking Water Supplies

Purpose

There is already considerable operational experience with the UV disinfection of drinking water globally and in the UK. Other countries have developed UV disinfection regulations and guidance manuals (ÖNORM 2001 and 2003; NWRI-AWWARF 2003; DVGW 2006; USEPA 2006) and several industry organisations have produced survey reports (e.g. UKWIR, AWWA) that provide detailed recommendations for the proper installation, maintenance, and operation of UV disinfection systems as well as cost summaries (Cotton et al. 2005; Bolton and Cotton 2008; Camm et al. 2008). The intention of this Policy Position Statement (PPS) is neither to re-state these previous recommendations nor to challenge any of them. Rather, this PPS is intended to set out CIWEM's current position on the UV disinfection of water supplies in light of the recent amendment to the Water Supply (Water Quality) Regulations and make recommendations for consideration in the UK water industry context.

CIWEM's Position on UV Disinfection

UV disinfection is now an established primary disinfection process that is recognised to be an effective treatment against a range of waterborne pathogens, including certain chlorine-resistant pathogens (e.g. Cryptosporidium), although it is less effective than chlorine against viruses. UV disinfection, properly implemented in conjunction with other treatment processes as part of an overall multi-barrier treatment strategy, can serve as an effective treatment for the control of certain microbial pathogens and may be the most appropriate treatment in some situations.

Key Recommendations for the UK Water Industry

1. There is currently no regulatory instrument in the UK to provide specific guidance on the proper installation, operation and maintenance of UV disinfection systems. With the recent amendment to the Water Supply (Water Quality) Regulations, it is recommended that the additional disinfection barrier provided by UV disinfection should be taken into account in current and future Drinking Water Safety Plans (Camm et al. 2008). In February 2010 the Drinking Water Inspectorate published an ultraviolet disinfection guidance document entitled "*Guidance on the use of Ultraviolet (UV) irradiation for the Disinfection of Public Water Supplies"*.
2. Proper dose monitoring and regular system maintenance are crucial for effective UV disinfection performance. UV disinfection systems installed in the UK should be properly validated, using standardised procedures, within their intended normal operating ranges

(e.g. flow rate, UV transmittance) to ensure a consistently achieved adequate UV dose with a justified margin of safety. It is the responsibility of the UV system manufacturer to provide validation documentation as well as instructions for the ongoing maintenance of the system (e.g. lamp replacement, sensor calibration).

3. A recent UKWIR report estimates that appropriately designed UV disinfection systems typically use less than 20 kWh/Ml of energy, versus 250-500 kWh/Ml typically for high lift pumping, and energy use by UV disinfection is comparable with, or less than, that for alternative treatment options of ozonation or membrane filtration for Cryptosporidium control (Camm et al. 2008). While overall energy consumption by water treatment facilities is certainly an important consideration in the UK water industry, energy usage on its own should typically not be a justification for ruling out UV disinfection as a viable treatment process option for a given treatment works.

4. UV disinfection should be considered as one component in an overall multi-barrier treatment strategy rather than a cure-all. For example, UV disinfection is most effective when turbidity is reduced upstream, e.g. by conventional coagulation, flocculation, sedimentation, and/or filtration. This is to prevent suspended particles from blocking the pathway between the UV light and target pathogens. Also, UK practice requires that a chemical disinfectant must be added post-UV disinfection to provide a secondary disinfectant residual for the distribution network.

5. Selection of UV disinfection for a particular treatment works needs to be considered on a site-specific basis, taking into account water quality, associated treatment and the nature and magnitude of the microbial challenge.

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Context

Ultraviolet (UV) disinfection involves the application of germicidal UV wavelengths to water, which damages microbial cell components and thereby prevents cell replication and renders pathogens harmless. UV disinfection has been proven to inactivate certain chlorine-resistant pathogens such as Cryptosporidium as well as a range of other waterborne pathogens. Applied at conventional UV doses, there is little to no known formation of regulated disinfection by-products associated with UV disinfection, which is an advantage over chemical disinfectants (e.g. chlorine, ozone). The increasing number of applications of UV disinfection in several countries throughout the world over the past decade (especially in North America, Europe) has led to the development of cost-competitive, optimised UV disinfection system designs that can be applied to a range of treatment plant sizes, from small groundwater systems up to water supplies for major cities (e.g. New York City). UV disinfection in the UK to-date has been mostly restricted to smaller groundwater sites (<10 Ml/d) (Camm et al. 2008).

A recent amendment to the Water Supply (Water Quality) Regulations for England and Wales came into force on 22 December 2007 (2007 Statutory Instrument No. 2734) and has direct relevance to the future of UV disinfection in the UK. Specifically, section 26(5) of the

amendment defines an "adequate treatment process" to now include any "process of blending or purification treatment which removes or renders harmless the value of concentration of any property of, organism or substance in, water, so that supplies do not constitute a potential danger to human health". The inclusion of the words "or renders harmless" removes a previous obstacle to the implementation of UV disinfection in water supplies, since UV disinfection inactivates microorganisms (e.g. Cryptosporidium) without physically removing them (e.g. as in membrane filtration).

References / Further Reading

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ÖNORM (2003). Plants for Disinfection of Water Using Ultraviolet Radiation – Requirements and Testing: Medium Pressure Mercury Lamp Plants. Austrian Standard 5873-2.

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Note: CIWEM Policy Position Statements (PPS) represents the Institution's views on issues at a particular point in time. It is accepted that situations change as research provides new evidence. It should be understood, therefore, that CIWEM PPS's are under constant review, that previously held views may alter and lead to revised PPS's. PPSs are produced as a consensus report and do not represent the view of individual members of CIWEM.