
Summary

i Reasons

Regulatory sampling of drinking water shows greater than 99% compliance with microbiological standards on public supplies but considerably lower compliance on private supplies. One factor affecting private supplies is believed to be inappropriate implementation of some UV systems.

This study has highlighted the critical differences between UV technologies used on public and private supplies, and established the suitability and performance of the most common UV system(s) used on private supplies.

ii Objectives

- Establish the range of UV technologies used on public and private supplies in England and Wales, and establish the critical differences in functionality and application.
- Review international standards for UV treatment systems to compare validation criteria and identify which criteria would demonstrate suitability for use in private supplies.
- Produce simple guidance for householders and local authorities to help in the selection and assessment of UV systems used in private supplies.

iii Benefits

This study has highlighted some major difficulties associated with the implementation of UV disinfection for private supplies. Addressing these difficulties will increase the reliability and performance of such systems.

iv Conclusions

UV technologies in public water supply

UV disinfection is widely used in public water supply, with most installations <10 MI/d but also larger installations >100 MI/d.

Design is usually based on detailed feed water quality data, with a dose of 40 mJ/cm² or higher for the majority of units. Dose validation according to ÖNORM, DVGW or USEPA is becoming the norm.

Monitoring and control is usually based on measurement of UV intensity; UVT is also measured and sometimes used for control. Feed water turbidity is monitored according to Regulation 26 requirements.

UV lamps are of the MP or LPHO type, with cleaning and replacement carried out routinely at supplier defined intervals. UV intensity monitors are routinely calibrated.

UV technologies in private water supply

UV disinfection used in private water supply is mostly $<10 \text{ m}^3/\text{d}$ (often much smaller); the larger units are usually installed at commercial premises rather than domestic.

Design may be based on limited feed water quality data, with pre-treatment specified to deal with poorer feed water quality. UV dose is typically 30 mJ/cm^2 for domestic units and 40 mJ/cm^2 for larger commercial units. Little, if any, biosimetric dose validation; some larger suppliers may carry out microbial challenge testing or hydraulic and UV intensity modelling.

Limited monitoring and control, particularly for domestic units, with control usually based on maximum flow rate and specified UVT of the feed water. No measurement of turbidity or UVT; some of larger commercial units may include UV intensity monitors which provide a shutdown rather than a control capability.

UV lamps are of the LP type, with cleaning and lamp replacement carried out annually (typically) by installers under service agreements in many cases; some simple systems may be serviced by owners.

Key findings from site visits to private supplies incorporating UV disinfection

There was a general lack of understanding amongst users regarding the treatment of their private supplies. This was compounded by the lack of information provided by equipment providers/installers.

There was no indication that UV equipment had been selected correctly for the flow or water quality.

Smaller private supplies and SDDs incorporated simple treatment, typically particulate filtration and/or UV disinfection. Some larger commercial private supplies incorporated more complex treatment systems.

UV equipment was generally serviced by specialist companies, plumbers or the users, with quartz sleeves cleaned at intervals between 2-12 months and lamps changed around every 12 months; the frequency of maintenance of other equipment and replacement of cartridge filters was less clear. Maintenance logs are generally not kept by users.

Monitoring and control of UV equipment is inadequate. Failure of a UV lamp may go undetected for some time because a lack of a prominent alarm, and will generally not prevent flow and the possibility of the consumption of non-disinfected water.

The potential for contamination of stored UV-treated water may not be well understood by users.

There is currently no licensing or approved contractor scheme applicable to the installation of equipment for private water supplies.

Review and comparison of standards and validation criteria for UV systems

UK (BSI) and international standards (USEPA (UVDGM), ÖNORM, DVGW, NWRI/WRF and NSF/ANSI) have been reviewed and compared.

The USEPA (UVDGM), ÖNORM, DVGW and NWRI/WRF standards apply to public water supplies.

The BSI standard applies to LP UV devices intended for water conditioning in buildings; the NSF/ANSI standard applies to point-of-entry and point-of-use LP UV equipment.

The BSI standard specifies a dose of 40 mJ/cm² validated by biodosimetry; the NSF/ANSI standard specifies a dose of 40 mJ/cm² (disinfection) or 16 mJ/cm² (supplemental bactericidal systems) validated by biodosimetry.

A reduction equivalence dose (RED) of 40 mJ/cm² as required by the ÖNORM (and DVGW) and BSI standards is the preferred validation criterion.

A UVI sensor is stipulated by all standards where UV is installed for disinfection applications. Such a sensor is considered desirable, but not necessarily essential, for private supply applications.

Design of a pilot study to evaluate a UV system for private water supplies

A pilot study based on either European (DVGW and ÖNORM) UV dose validation or US (UVDGM) UV dose validation is proposed to evaluate a UV system spiked with surrogate microorganisms under a range of flow, UV lamp intensities (doses) and water quality (UVT) conditions.

v Recommendations

A number of key recommendations are suggested that would improve the reliability and performance of UV disinfection for private supplies:

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- A licensing or approved contractor scheme should be implemented for installers of equipment for private water supplies.
 - Copies of manufacturers'/suppliers' operating and maintenance instructions should be provided and retained by the supply owner. In addition, a maintenance log should be maintained by the owner to record details of maintenance carried out and schedules for future maintenance.
 - Audible and visual alarms should be more prominent, particularly where the UV system is sited away from the user's premises.
 - UV systems should include automatic shutdown of the water supply in the event of power or lamp failure. An emergency valved by-pass line could be incorporated with instructions to boil drinking water prior to consumption (whilst the UV system awaits repair).