deciding on UV Disinfection

How UV was used for municipal water disinfection in Busselton, Western Australia

By Jon McClean

Busselton Water is an independent water authority supplying water to domestic, commercial and light industrial consumers in the town of Busselton in Western Australia. The town's population is approximately 25,000, but during weekends and holidays this can increase to 65,000. Annual water consumption is about 950 million gal, with an annual growth rate of 8%.

All the water is produced from artesian bores between 980 and 2,600 ft deep, drawing on two aquifers. The water is slightly alkaline and is produced at temperatures ranging from 79 to 100°F. The peak flow rate from each of the four plants operated by Busselton Water is currently about 60 gal per second.

Busselton's water supply differs from most municipal sources in Australia because the deep aquifers offer high microbiological integrity and low organic carbon loadings. Most other municipal water providers draw water from shallow production bores, open water bodies or a combination of sources that contain particulates such as dispersive clays, plant material and algal debris.

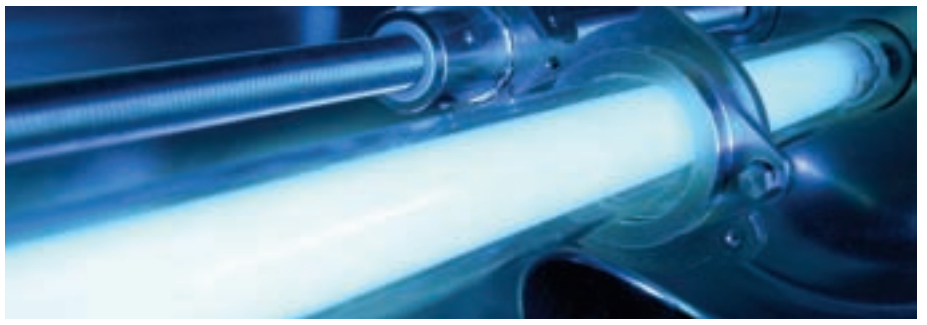
The Requirement for Water Disinfection

In the past, Busselton Water has not disinfected its water supplies, and historically, the water has been free from microorganisms. However, under the Australian Drinking Water Guidelines, set up by the National Health & Medical Research Council and the Agricultural & Resource Management Council of Australia & New Zealand, all water supplies should be disinfected.

Disinfection Technologies

To assist in identifying the most suitable disinfection technology, Busselton Water commissioned local groundwater consultants Rockwater PTY, Ltd. to investigate the available methods and make recommendations for a suitable system. The objective of the study was to determine a disinfection system that effectively met the Australian Drinking Water Guidelines. Rockwater found that none of the disinfection methods it investigated met all of the requirements, so a compromise was necessary to obtain the optimum process for Busselton's reticulation system.

The five most commonly used methods of disinfection—chlorination, chloramination, chlorine dioxide, ozonation and ultraviolet (UV) irradiation—were all investigated.



Each of the eight UV systems installed at Busselton contains a medium-pressure UV lamp.

The Decision to Use UV

UV was finally selected because it met all of the design criteria except for one: maintaining a persistent residual barrier. However, the water is maintained in a closed system following treatment; the chance of contamination is minuscule given that, in the past, the water supply maintained compliance without any disinfection.

Chlorination achieves only one of the conditions in the 1996 guidelines: it maintains a residual barrier, but it breaks down rapidly. To maintain sufficient residual disinfection at the outer extremities of the system, it may have been necessary to exceed the maximum dose rate at the point of disinfection. Chlorination is also a less effective disinfectant than UV at the recommended dose rates.

UV installation costs at Busselton were estimated to be about 2.2 times those for chlorination and chloramination disinfection systems, but only half the cost of chlorine dioxide systems. UV operational costs, however, were estimated to be about 25% of those for chlorine.

The guidelines state that the implementation of a disinfection system should be a consultative process involving the community. In a previous survey, residents of Busselton had strongly objected to a proposal to chlorinate the town's water supply, so it was decided to adopt UV as the sole method of disinfection. To achieve a confident level of bacteria destruction, a minimum dose rate of 30 mW-sec/cm^2 was recommended.

UV Installation & Testing

Following a successful 12-month trial of two single-lamp, medium-pressure UV units, engineers decided to install eight systems. Each of the UV systems contain a single medium-pressure UV lamp housed in a protective quartz sleeve. The lamps are polychromatic, producing a UV output at wavelengths between 200 to 300 nm, with a peak output between 240 and 280 nm, which has been shown to be the wavelength range most effective against bacteria. UV monitors detect the UV output of each lamp, and variable power controls allow output to vary as flow rates increase or decrease. Automatic wipers keep the quartz sleeves surrounding the UV lamps free from organic fouling.

Water transmissivity is measured using a dedicated transmittance monitor—a patented device that continuously

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measures water transmittance and feeds the data to a control unit. For a high-quality, stable groundwater source like Busselton's, however, transmittance has been assumed to be constant; therefore, a figure of 90% (when measured against double-distilled water) was used. The UV dose is displayed in mW-s/cm^2 or mJ/cm^2 on a control panel, which is capable of data logging variables such as water flow, UV dose, UV intensity and wiper frequency. This record allows any faults to be date- and time-stamped.

Each UV system operates in duty/standby mode. The power to each lamp is continuously varied, ensuring that the specified UV dose is always delivered. Both systems may be operated at 50%.

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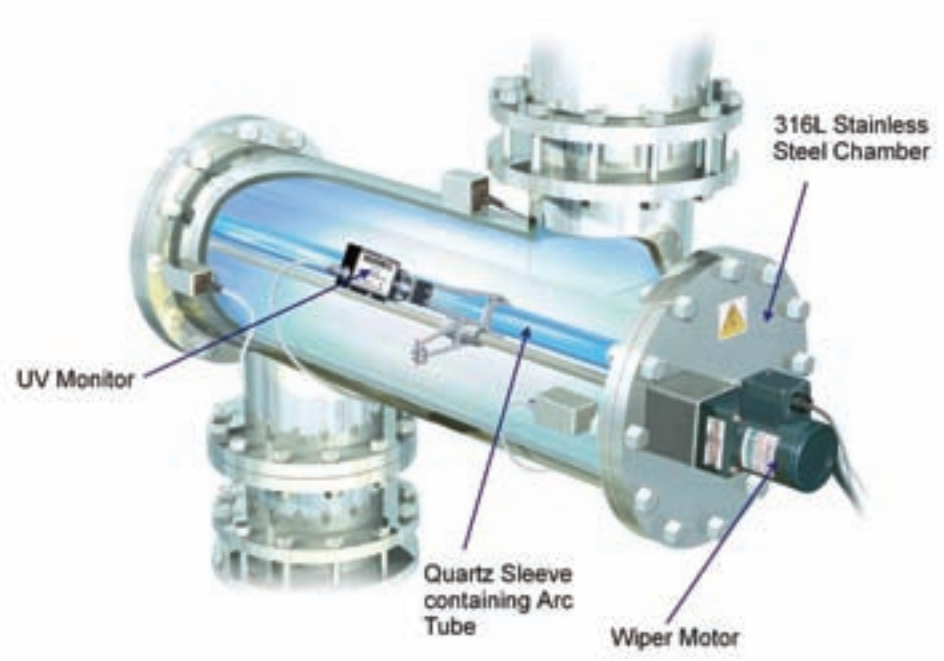
In the event of failure, a hot standby is available immediately. The operating protocols are strictly fail-safe and will not under any circumstances allow untreated water forward. The control panel provides a broad range of signals to actuate valves, initiate pumping and provide meaningful monitoring and control of the system.

Summary

Following the introduction of the Australian Drinking Water Guidelines, the Busselton Water Board in Western Australia was required to disinfect its municipal water supply. The water had not previously been disinfected because its origin in deep artesian aquifers made it microbiologically pure. Following an



A UV system provided Busselton with the best overall disinfection.

extensive investigation of available disinfection technologies, UV was chosen as the most appropriate method because it met all the design criteria except for one: providing a residual disinfection.

This was not seen as a drawback, however, because Busselton's water supply is maintained in a closed system after treatment. The chance of contamination was also seen as minuscule since the water supply had previously been compliant without any disinfection. Following a 12-month trial, eight additional pressure units were installed to treat the entire Busselton network. *wqp*

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