Atlantium
Illuminating Water Technologies

APPLICATION BRIEF

Advanced Oxidation Process (AOP)
Hydro-Optic™ Technology

Atlantium's Hydro-Optic™ UV AOP Technology Effectively Removes 1,4-Dioxane and Other Harmful Organic Compounds

The Advanced Oxidation Process (AOP) is a well-established method for treating drinking water contaminated with organic compounds, such as 1,4-dioxane and trichloroethylene (TCE). In the AOP process an oxidizer compound is broken down to generate hydroxyl (OH) radicals that react with organic and inorganic compounds in the water. Some compounds, such as 1,4-dioxane and TCE, react with the OH radical more readily than others.

The most used AOP method involves the use of ultraviolet (UV) radiation, which degrades radical donors, usually hydrogen peroxide (H_2O_2) to OH radicals (designated UV/H_2O_2).

Atlantium offers a novel AOP process based on its Hydro-Optic™ (HOD) UV technology that uses proprietary medium pressure (MP) lamps that provide polychromatic UV light (200–410nm). The HOD UV technology offers improved efficiency for organic reduction with superior monitoring capabilities over other AOP technologies to assure compliance.

The HOD UV lamps produce a high-density broad-spectrum UV light inclusive of wavelengths were H_2O_2 absorbs light with higher efficiency [1]. Whereas, the absorption of H_2O_2 at 254nm is poor (Figure 1). The impact on 1,4-dioxane destruction is that the HOD UV technology is more efficient than low pressure (LP) lamps at photolysis of the oxidizing compounds (i.e. H_2O_2 or HOCl). The product of these are radicals, which in turn oxidize 1,4-dioxane efficiently (Figure 2).

HOD UV systems require less lamps to achieve the same UV dose as LP systems. This significantly reduces the maintenance requirements of the HOD UV technology compared to complex LP systems that use ten times more the number of lamps.

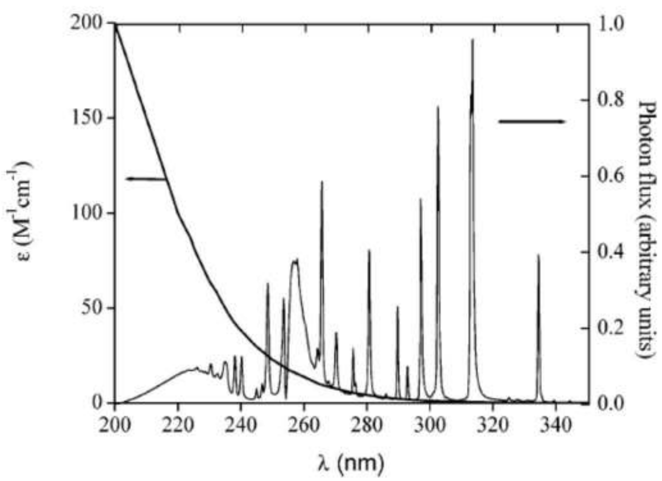

Figure 1:
Medium pressure (MP) lamp spectrum (black line) against the adsorption of hydrogen peroxide (bold black line).

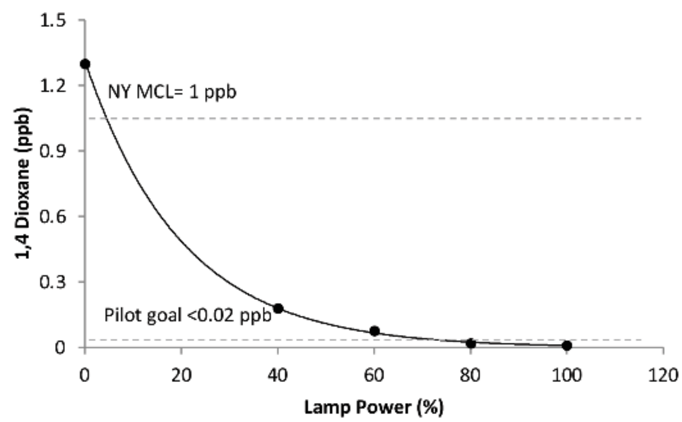

Figure 2:
Degradation of 1,4-dioxane from an initial concentration of 1.3 ppb to below the analytical detection limit of 0.02 ppb or 0.07 ppb and the New York maximum contaminant level (MCL) of 1 ppb. 100% data point is below detection limit and is represented as 0.01 for illustration.

Most importantly, when a UV system has a small number of lamps they can be monitored individually and increase reliability. Chemical contaminants are not monitored continuously or even daily so choosing a system that reliably delivers and monitors the required UV dose is critical.

Atlantium uses an advanced and proprietary control system, featuring real-time water quality and lamp performance monitoring to ensure treatment efficacy. The HOD UV technology measures %UVT, flow rate, and UV lamp intensity (kW) in real time to maintain the minimum required UV dose. UVT is an indicator of water quality and designates the percentage of UV light that passes through the water.

Atlantium's HOD UV systems (Figure 3) monitor each MP lamp individually to make sure that — "what you see is what you get". As UVT and lamp output are measured separately, the HOD UV system automatically adjusts lamp power when conditions fluctuate so that the minimum required dose set by the user is guaranteed to be delivered.

Figure 3:
Hydro-Optic™ (HOD) UV system offers improved efficiency for organic reduction with superior monitoring capabilities over other AOP technologies to ensure compliance.

In a pilot test in Long Island, New York, the HOD UV technology demonstrated complete removal to 1,4 dioxane. The goal of the project was to see the degradation of 1,4-dioxane from an initial concentration of 1.3 ppb to below the analytical detection limit of 0.02 ppb or 0.07 ppb and the New York maximum contaminant level (MCL) of 1 ppb.

Data from this pilot is shown in Figure 2.

[1] S. Goldstein, D. Aschengrau, Y. Diamant, and J. Rabani, "Photolysis of aqueous H_2O_2: Quantum yield and applications for polychromatic UV actinometry in photoreactors," *Environ. Sci. Technol*., vol. 41, no. 21, pp. 7486–7490, 2007.

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