TROJAN UV™

CASE STUDIES

Environmental Contaminant Treatment

Trojan UV Solutions for Water Scarcity: Treating Trace Contaminants and Disinfecting with UV in Drinking Water

The TrojanUVPhox™ at the Aurora Reservoir Water Purification Facility

The City of Aurora is taking an innovative approach to prepare for the city's water future. This effort is known as the Prairie Waters Project. The project is enabling the City of Aurora to maximize its use of water that it already owns from the South Platte River, and will add to the city's ability to provide its citizens high quality, pure drinking water. A key component of this strategy is the construction of the Aurora Reservoir Water Purification Facility (ARWPF). The facility will use a multi-step purification process that features a state-of-the-art Trojan ultraviolet (UV)-oxidation and disinfection system.

TREATMENT PROCESSES AT THE ARWPF

Many waterways are under the influence of water that may contain environmental contaminants such as agricultural runoff or industrial/municipal wastewater discharge. These non-natural sources may carry nitrosamines, pesticides, pharmaceuticals, personal care products or other environmental contaminants. Water from the South Platte River, like many other sources in North America, receives water from these types of sources. To meet Aurora's stringent water quality goals, an advanced treatment process will be utilized to provide multiple purification barriers to contaminants potentially present in the source water.

The ARWPF will utilize bank filtration (aquifer recharge and recovery), precipitative softening, the TrojanUVPhox™ UV-oxidation system, biological filtration and granular activated carbon filtration. Testing has shown that this treatment process effectively purifies the water to beyond drinking water standards. Trojan UV-oxidation was selected as a primary treatment process at this facility for its superior disinfection capabilities and for its ability to destroy micropollutants without forming harmful by-products. UV-oxidation acts as a powerful barrier to both pathogens and chemical compounds.

TROJAN UV-OXIDATION AT THE ARWPF

Through proper sizing and by adding a small amount of hydrogen peroxide upstream of the UV system, the TrojanUVPhox™ will act as a barrier to a variety of compounds. Examples include taste and odor-causing compounds such as MIB and geosmin, pharmaceuticals such as ibuprofen and acetaminophen, hormones such as estrogens and testosterone, pesticides such as atrazine and isoproturon, and various nitrosamines (an emerging contaminant group that includes *N*-nitrosodimethylamine [NDMA] and *N*-nitrosodiethylamine [NDEA]). The system will also inactivate microorganisms, viruses, and chlorine-resistant pathogens.

The TrojanUVPhox™ was selected after a

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cost-benefit evaluation of potential purification approaches was conducted by the engineer (CH2M Hill) and the City of Aurora. Other technologies such as ozone were also evaluated. Trojan UV-oxidation was selected for its ability to:

- Provide superior disinfection of chlorine-resistant microorganisms in a single unit process
- Accomplish treatment of NDMA and other nitrosamines
- Act as a barrier to multiple contaminant classes such as taste and odor-causing compounds, pharmaceuticals, steroids, pesticides and nitrosamines
- Perform treatment without creating disinfection by-products such as bromate

SYSTEM DESIGN PARAMETERS

- FLOW CAPACITY: 50 million gallons per day (7,886 m³/hr)
- DESIGN LOG REDUCTION OF NITROSAMINES: 1.2-log
- OXIDANT: hydrogen peroxide at 5 parts per million
- UV TRANSMITTANCE (UVT): >85% at 254 nm
- DISINFECTION METHOD: UV

TROJANUVPHOX™ ELIMINATES THE NEED FOR MEMBRANES

The use of UV-oxidation for contaminant treatment, along with the multi-barrier treatment train, also makes it possible to reduce or eliminate a plant's reliance on reverse osmosis (RO) membranes. RO systems reject 10% to 20% of influent water as a brine waste stream. This waste stream reduces the amount of water available for use and is difficult to dispose of, especially in landlocked communities such as Aurora. The TrojanUVPhox™ will perform functions similar to that performed by RO, such as treatment of endocrine-disruptor compounds, pharmaceuticals and personal care products and other chemical contaminants, without producing a brine stream. In addition, while nitrosamines and other contaminants can pass through membranes, the UV-oxidation system will act as an effective and reliable barrier to such compounds, especially NDMA.

NITROSAMINES

Nitrosamines, particularly *N*-nitrosodimethylamine (NDMA), are compounds that are formed as disinfection by-products in water and wastewater treatment systems. Nitrosamines cannot be effectively treated with other advanced water treatment technologies such as ozone, activated carbon or RO. Nitrosamines are effectively treated with UV light by way of a process known as UV-photolysis. A variety of regulatory agencies are acting to limit consumers' exposure to nitrosamines. For example, at the federal regulatory level in the U.S., nitrosamines have recently been included on the EPA's proposed Unregulated Contaminant Monitoring Rule (UCMR). The State of California has set a Notification Level for NDMA at 10 parts per trillion and a Public Health Goal of 3 parts per trillion. For more information, please refer to Trojan's fact sheet on the nitrosamine group.

DEMONSTRATION TESTING

Although the performance of UV-oxidation for the treatment of contaminants is a proven process, during the design of the TrojanUVPhox™ system for Aurora, CH2M Hill performed a number of experiments to assess performance using actual water from the source.

Using bench- and pilot-scale UV-oxidation systems, the log reduction of NDMA, MIB, geosmin, microcystin (an algal toxin), atrazine (pesticide), and chlorotetracycline (pharmaceutical) was determined by simulating the expected full scale operating conditions (i.e. full scale UV energy and hydrogen peroxide concentration). The results are given in **Figure 1.**

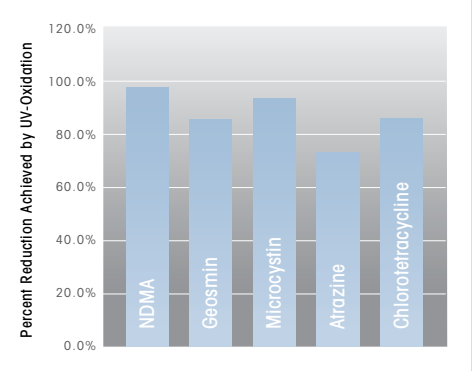

Figure 1. Removal of various organic compounds with UV-oxidation (UV plus hydrogen peroxide, derived from Swaim 2006)

Swaim, P. (2006). Innovative Approaches to Water Purification Using UV-Oxidation. CDROM Proceedings of the Annual Conference of the American Water Works Association, San Antonio, TX. June 11-15, 2006.

TROJAN UV™
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