TROJAN UV™

CASE STUDIES

Environmental Contaminant Treatment

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

The Groundwater Replenishment System, **ORANGE COUNTY**, California

The Groundwater Replenishment (GWR) System, located in Orange County, California, USA, provides purified recycled water for aquifer recharge and for injection into area aquifers to prevent seawater intrusion. The GWR System is a joint project between the Orange County Water District (OCWD) and the Orange County Sanitation District (OCSD). It is the largest indirect potable reuse project of its kind in the world and utilizes the most advanced water treatment technology available. The GWR System treats and reuses wastewater that, in the past, had been discharged to the ocean. The water is reused to provide protection against drought and as a means of achieving a sustainable water supply.

The full-scale advanced treatment system takes filtered secondary effluent from the neighboring OCSD treatment plant and converts it to water that exceeds all drinking water quality standards. The 70 million gallon per day (MGD) system consists of microfiltration (MF), reverse osmosis (RO), and the TrojanUVPhox™ UV-oxidation/disinfection system.

THE TROJAN UV SOLUTION

While MF and RO provide treatment for a variety of organic compounds, there are a number of contaminants that, due to their small molecular size (among other reasons), can pass through even the most advanced RO membranes. Common in wastewater, a compound known as *N*-nitrosodimethylamine (NDMA) is present at the GWR System as a by-product formed during upstream wastewater treatment processes. NDMA is formed primarily from the combination of certain precursor chemicals, coagulants, and chlorine in wastewater treatment plants. The NDMA molecule is considered to be carcinogenic at very low concentrations and, although it passes through MF and RO membranes, it is destroyed with ultraviolet (UV) light by a photochemical process known as UV-photolysis. In addition, using a low concentration (3 parts per million [ppm]) of hydrogen peroxide, the system initiates an oxidation reaction that destroys other contaminants such as pharmaceuticals or industrial contaminants that have been shown to be present in secondary effluent. Together with the other treatment processes in the GWR System, the TrojanUVPhox™ creates extremely high quality water from wastewater that would otherwise be lost to the ocean. The treatment objectives accomplished by the TrojanUVPhox™ are:

1. Destruction of nitrosamines and other contaminants treated by UV-photolysis (UV alone)
2. Destruction of pharmaceuticals, personal care products, and industrial chemicals treated by UV-oxidation (UV + hydrogen peroxide)
3. Microbial disinfection
4. Additional protection: a cost-effective, easy to understand additional barrier that helps build public confidence in treated water

CASE STUDIES

The TrojanUVPhox™ System consists of the UV Reactor System, a hydrogen peroxide storage and metering system and a Trojan Optiview™ UV transmittance monitor. The low-energy TrojanUVPhox™ minimizes electrical consumption by using Trojan's high-efficiency amalgam lamps. The TrojanUVPhox™ effectively meets the peak flow demand within the design space constraints. It has a footprint comparable to, or even smaller than, the medium-pressure lamp-based UV system that was also considered for the project.

The water providers of Orange County are taking a proactive role in meeting the water supply needs of the region. In doing so, they have garnered widespread public support for the project (for more information, visit **www.gwrsystem.com**). A key component of their efforts has been the design of a treatment process that provides multiple barriers to chemical and microbial contaminants and meets California Department of Public Health Notification Levels for chemicals such as NDMA (Notification Level of 10 parts per trillion [ppt]) and 1,4-dioxane (Notification Level of 3 parts per billion).

DEMONSTRATION TESTING

In order to obtain an operating permit for the TrojanUVPhox™ System, a 5 MGD demonstration system underwent extensive performance testing to demonstrate both NDMA destruction and microbial disinfection.

The disinfection capability of the TrojanUVPhox™ was determined by measuring the log inactivation of MS2 bacteriophage seeded into the influent stream upstream of the UV system. In a similar fashion, its ability to destroy NDMA was determined by measuring the influent and effluent NDMA concentrations.

The GWR System design specifications and the 2003 NWRI/AWWARF UV Guidelines require validation of >100 mJ/cm^2 delivered dose, >4 log inactivation of MS2, and >1.2 log reduction of NDMA.

PROVEN PERFORMANCE

The performance of the TrojanUVPhox™ treatment system exceeded DHS performance requirements and OCWD design criteria. As illustrated in **Figure 1**, the system effectively reduced NDMA to below the 10 ppt treatment level given an influent concentration of 150 ppt. Second, given an influent concentration of MS2 that allowed demonstration of a 5-log reduction, the TrojanUVPhox™ completely eliminated the MS2 bacteria in the effluent, leaving zero plaque forming units per milliliter (PFU/mL). This 5-log reduction in MS2 is shown in **Figure 2**. The dose required to perform this reduction is in excess of 100 mJ/cm^2 and was achieved with only a fraction of the total system in operation.

FULL SCALE SYSTEM DESIGN PARAMETERS

- Average flow capacity: 70 MGD
- Peak flow capacity: 100 MGD
- Future flow capacity: 130 MGD
- Design influent NDMA concentration: 150 ppt
- Target effluent NDMA concentration: <10 ppt
- Oxidizer: hydrogen peroxide at 3 ppm
- Ultraviolet transmittance (UVT): >95% at 254 nm
- Disinfection method: UV

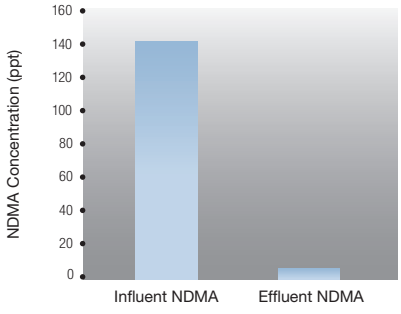

Figure 1. Log of the influent and effluent concentrations of NDMA (representative test with a fraction of the total system operational, 5 MGD flowrate)

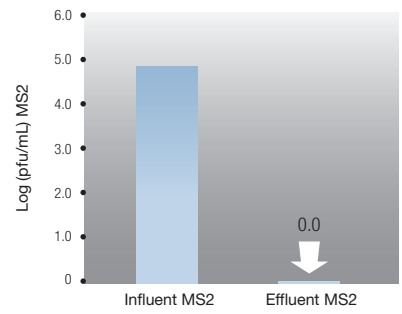

Figure 2. Log of the influent and effluent concentrations of MS2 (representative test with less than 20% of the total system in operation).

TROJAN UV™
WATER CONFIDENCE™

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