Advanced Oxidation Processes

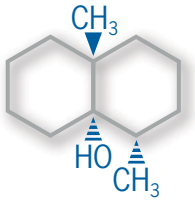
Pure Water. Clean Air. Better World.

CalgonCarbon
A Kuraray Company

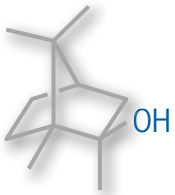
Calgon Carbon UV Advanced Oxidation

Calgon Carbon recognizes the vital role of efficient, effective water treatment and management. Since introducing one of the first UV advanced oxidation processes to remediate contaminated groundwater three decades ago, our UV Technologies Division continues to uphold our commitment to safe, clean and sustainable water supply. Today, our installations are treating a wide array of contaminated drinking water, wastewater, groundwater, process water and ballast water. With storied successes, including more than 400 Rayox® and Sentinel® installations spanning five continents and treating over 6 billion gallons per day, we still take our work very seriously.

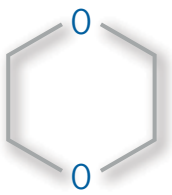
Calgon Carbon's UV Advanced Oxidation Processes (AOP) provide a proven treatment option to various contaminants in groundwater as well as industrial process and waste streams. This includes chlorinated alkenes (DCE, TCE, PCE), 1,4-Dioxane, Vinyl Chloride, NDMA, and many other contaminants of concern. The UV/AOP process is capable of treating a variety of contaminants on its own that are not easily removed with other treatment technologies, but can also be combined with those other technologies to increase overall treatment efficiency and operating costs.



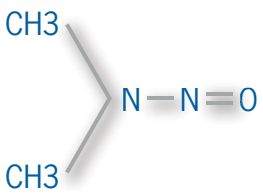
Geosmin



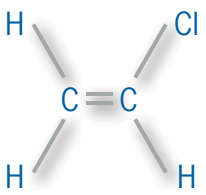
MIB



1,4-Dioxane

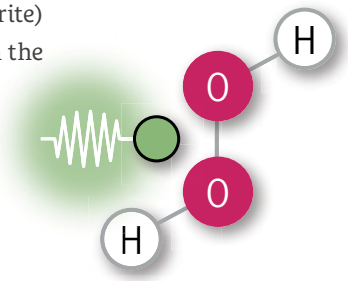


NDMA



Vinyl Chloride

The Advanced Oxidation Process uses an oxidizing agent (hydrogen peroxide or hypochlorite) in combination with UV to produce Hydroxyl radicals (•OH). These radicals then react with the dissolved contaminants, initiating a rapid cascade of oxidation reactions that ultimately fully oxidize (mineralize) the contaminants. This reaction is typically several million times faster than chemical oxidants, such as ozone and hydrogen peroxide, making this process very efficient. In addition, some components are treated by the direct absorption of UV light in the UV-C spectral range emitted by UV lamps, most notably NDMA.



Calgon Carbon's Medium-Pressure UV/AOP Technology

Over 400 advanced oxidation applications have been installed from industrial and groundwater remediation applications to indirect reuse and drinking water distribution. Calgon Carbon has installed systems and obtained regulatory approval to treat drinking water for 1,4-Dioxane, taste and odor treatment, and algal toxins (microcystin).

The Rayox UV/AOP system has been treating highly contaminated waters for decades. When pioneering the use of UV light for disinfection, Calgon Carbon applied that same tried-and-true technology to its Sentinel drinking water reactors, providing them with enough power to achieve the high UV doses required for UV/AOP treatment.

- High-intensity medium-pressure lamps
- Automatic Quickswipe Stainless Steel cleaning system
- Automated operation and PLC-based controls
- Robust long-life electromagnetic ballasts with superb voltage tolerance
- Safe automatic emergency shutdown
- 316 SS Reactor Vessel
- 480V / 3PH / 60 Hz

Rayox UV/AOP system

Developing Site-Specific Control Strategies

Individual contaminants have a distinct reaction rate constant with the hydroxyl radical, which is determined by laboratory analysis using the science of chemical kinetics. The reaction rate constant determines the rate at which the chemical will react and subsequently be oxidized by the hydroxyl radicals generated by the UV-Oxidation process.

Background Total Organic Carbon (TOC) competes for hydroxyl radicals, often called “scavenging,” because it consumes hydroxyl radicals that would otherwise contribute to the oxidative degradation of the target contaminants. Because TOC is a generic measurement, the reaction rate constant will be a blend of the reaction rate constants of the individual constituents that contribute to the overall TOC content of the water. The TOC reaction rate constant must be determined using bench scale testing to provide process guarantees.

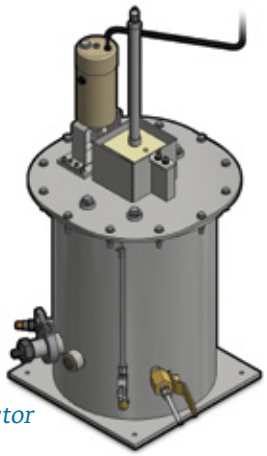
Calgon Carbon can offer testing services to help characterize this scavenging and develop a customized dose sensitivity for each application. The customized dose sensitivity helps simplify the operator experience by allowing them to specify a log reduction value for the target contaminant. The system will then control to that setpoint and optimize oxidant and UV dosing to keep operating costs low.

Bench Scale Testing

Representative effluent from the site processes can be tested at Calgon Carbon’s R&D laboratory to determine the size of a full-scale system and provide a process guarantee.

The process involves the use of our Rayox Batch Reactor and the aim is to characterize the reaction rate constant of the background TOC.

Site process water is added to the batch reactor, hydrogen peroxide (or hypochlorite) is dosed at levels anticipated based on modeling, and then samples are taken at predetermined UV doses to develop a treatment curve and size the full-scale system.



Rayox Batch Reactor

1,4-Dioxane

1,4-Dioxane is a synthetic industrial chemical which is completely miscible in water. It is highly mobile in groundwater and is not shown to be readily biodegradable in the environment. It is classified by the U.S. EPA as likely to be carcinogenic to humans by all routes of exposure. Currently, there is not a federal maximum contaminant level established for 1,4-Dioxane in drinking water, but many states are developing recommended limits. Although many sources of 1,4-Dioxane are no longer in use, its physical and chemical properties allow it to remain in groundwater for years after initial contamination.

1,4-Dioxane has a low molecular weight, is highly soluble in water, and is not readily volatile, making more common treatment techniques, such as carbon adsorption, air stripping, reverse osmosis or biological treatment, unfavorable.

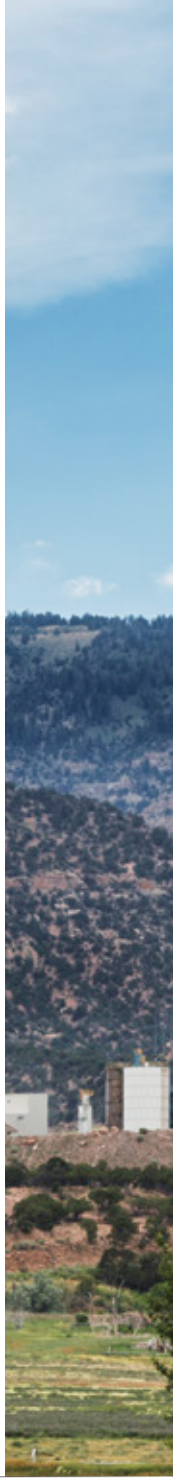
Sources and Uses

- Used as a stabilizer for chlorinated solvents, particularly 1,1,1-trichloroethane (TCA)
- Found in products, such as paint stripper, dye, grease, varnish, wax, antifreeze, aircraft deicing fluid, and in consumer products, including deodorant, shampoo, and cosmetics
- Used as a purifying agent in the manufacture of pharmaceuticals
- Is a byproduct of the manufacture of polyethylene terephthalate (PET) plastic
- May be present in some food supplements, food containing residues from packing adhesives, or on food crops treated with pesticides that contain 1,4-Dioxane as a solvent or inert ingredient

Sentinel UV Reactor

Application-Specific Products

	Rayox	Sentinel
Applications	Industrial and Remediation Highly contaminated waters	Municipal Low-Level Contamination and Taste & Odor events Validated per UVDGM requirements and can be dual-purposed to obtain disinfection credit
System Configuration	Control/Power Panel integrally mounted with UV reactors on a single skid.	Control/Power Panel can be installed up to 500 feet from reactors.
Flow Rate	5 to 300 gpm	1 to 52 MGD
Flange Sizes	1-1/2- to 4-inch	12- to 48-inch
Lamp Power	Up to 27.5 kW per lamp	4-20 kW per lamp
Lamps Per Reactor/Skid	Up to 4 lamps per skid	Up to 18 lamps per reactor
Design Pressure	25 psi 50 psi (optional)	50-150 psi



About Calgon Carbon a Kuraray Company

Calgon Carbon is an acknowledged leader – nearly 75 years in production - in the activated carbon and reactivation industry for many liquid and vapor phase applications, with complementary expertise in ultraviolet disinfection and oxidation, ion exchange technology, and ballast water treatment.

As the activated carbon industry forerunner and with ultraviolet light disinfection and oxidation expertise, Calgon Carbon has originated cutting-edge purification systems for drinking water, wastewater, odor control, pollution abatement, and a variety of industrial and commercial manufacturing processes.

For more information about Calgon Carbon's leading activated carbon, filtration media and ultraviolet technology solutions, visit www.calgoncarbon.com.

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