



CALGON CARBON CORPORATION

UV Technologies Division



SENTINEL[®] UV Disinfection System

Making Water and Air Safer and Cleaner

SENTINEL® UV Disinfection

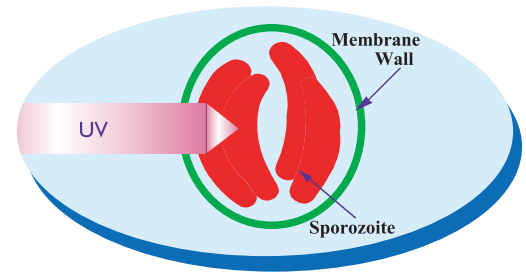
Calgon Carbon's SENTINEL® UV Disinfection system represents a significant breakthrough in the disinfection of drinking water supplies.

The commercialization of SENTINEL® in 1999 means that UV disinfection can be an effective, reliable barrier against viruses, bacteria, and parasites such as *Giardia* and *Cryptosporidium* at a fraction of the cost of other treatment technologies.

Cryptosporidium and *Giardia*, microscopic parasites present in almost all surface waters, are highly resistant to traditional treatment methods such as chlorination. When ingested through drinking water, they can cause illness characterized by severe abdominal cramps and diarrhea. This illness can be fatal in individuals with suppressed immune systems.

Until a few years ago, UV disinfection was not considered cost-effective for controlling of *Cryptosporidium* and *Giardia* cysts and oocysts. Pioneering research, launched and funded by Calgon Carbon Corporation in 1996, led to an inventive process for inactivating these organisms and rendering them non-pathogenic.

This inventive process was accorded both U.S. and foreign patents (U.S. Patent Numbers 6,129,893 and 6,565,803), and is the heart of the SENTINEL® UV system.



Calgon Carbon's patented process provides better than 99.99% inactivation of both *Cryptosporidium* and *Giardia* at UV doses of less than 10mj/cm². The results of this innovative process contradicted all previous tests on the merits of UV to protect drinking water and led to the patenting of the process in 1998. In addition to inactivating *Cryptosporidium*, the SENTINEL® System also inactivates *E. coli*, *Giardia*, rotavirus, and other pathogens.

Over the past several years, Calgon Carbon has obtained additional validation for other models of the SENTINEL® UV system through independent third parties such as the Portland Validation Center operated in the U.S. and the German DVGW. Calgon Carbon Corporation has the highest flow UV reactor (40 mgd) validated under the U.S. EPA Disinfection Guidance Manual.



The SENTINEL® 48"
Validated to treat up to 40 mgd
(the highest flow in the industry)

The SENTINEL® System offers many unmatched advantages

- **LOW COST.** Medium-pressure UV technology achieves a >3 log inactivation of *Cryptosporidium* for pennies per 1,000 gallons.
- **PROVEN EFFECTIVE.** NSF/EPA verified and third-party validated under the new EPA Long Term 2 enhanced surface water treatment rule in the United States.
- **FLEXIBLE DESIGN.** Multiple sizes can be retrofitted easily into existing systems. We currently have four validated reactor systems - 12", 18", 36", and 48" - handling <1 mgd up to 40 mgd per reactor.
- **CLEAN.** No disinfection by-products.
- **SAFE.** Automatic shutdown for operator safety.

Highly Efficient Performance

SENTINEL® outperforms conventional technologies by 300 percent and more based on comparison of operational costs.



SENTINEL® vs. Conventional Technologies Comparison for Typical 10 MGD Installation

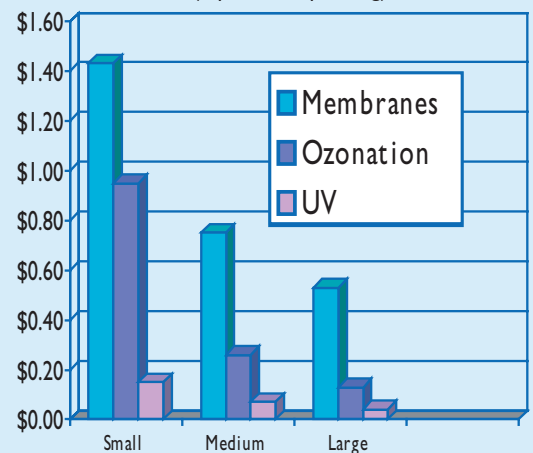
	SENTINEL®	Ozone 22°C	Ozone 7°C	Membranes
Capital Cost (\$000)	350 ¹	1,550	3,000	5,000
Operational Cost (\$/1000 Gal.)	<0.01 ¹	0.01-0.04	0.05-0.08	0.30
Effectiveness (No. of log inactivation)	>3	2-3	2-3	>3
Secondary Treatment Requirements	None	Minor	Minor	Major
Retrofitability	Excellent	Poor	Poor	Poor
By-products	None	Bromate, AOC	Bromate, AOC	None
Dimensions	Small	Large	Large	Large
Service Requirements	Infrequent	Occasional-Frequent	Occasional-Frequent	Occasional-Frequent
Occupational/Environmental Risks	Low	Medium	Medium	Low

(1) Based on dose of 1kW/mgd

Source:
Industry Data - Spring 1998

- Membranes and UV: assume 2.5 log reduction
- Ozone: 1-2 log reduction

Cryptosporidium Inactivation Costs (capital and operating)



Features of the SENTINEL® Design

- High-intensity Medium-Pressure Lamps with typical outputs 20 to 200 times higher than Low-Pressure.
- Quickwipe™ automated quartz cleaning technology means no manual cleaning and no chemicals required.
- Easy and fast installation due to simple processes and electrical connections.
- Third-Party certified Intensity Sensor assures accurate dose is being applied.
- Fully automated operation and control system with safety alarms.
- Flexible, compact design, with small footprint and modular components that can be easily retrofitted into existing systems.
- Highest output to footprint ratio in the industry.
- Robust electromagnetic power supply that lasts longer and is more stable than electronic power supplies.
- Isolated lamp power supply and control cabinet for safe and convenient location.
- UV lamps guaranteed for 5,000 hours of life.



Calgon Carbon's UV Technology Leadership and Experience

Calgon Carbon Corporation's UV Technologies Division has over 350 systems built and 20,000 kW of medium-pressure lamps installed for treating a broad spectrum of contaminated groundwater, wastewater, process water, and drinking water.

Company Overview

Calgon Carbon Corporation (NYSE: CCC) has been a global leader in services and solutions for making water and air safer and cleaner and for purifying food, beverage, and industrial process streams. Headquartered in Pittsburgh, Pennsylvania, USA, Calgon Carbon employs approximately 1,200 people at 18 carbon manufacturing, reactivation, and equipment fabrication facilities, and 27 sales and service centers. Calgon Carbon is known as Chemviron Carbon in Europe, the Middle East, and Africa.

Calgon Carbon's expertise spans many fields including activated carbon, UV technology, continuous ion exchange, and chromatography. For any application from drinking water purification to pharmaceutical manufacturing, Calgon Carbon

The SENTINEL® system has a large installed base of drinking water systems treating from 1 to 100 mgd since 1999. In addition, SENTINEL® has met the requirements of third party validation testing in both Europe and North America.

technologies are designed to enhance production efficiencies, minimize waste, and remove pollutants—in short, making the world a cleaner, safer place.

Calgon Carbon serves more than 4,000 customers around the world. In 2004, the company's sales totaled \$336 million.

Customer and Technical Service

Customers at thousands of installations across the globe trust Calgon Carbon's extensive network of skilled service technicians to provide the support they need every day. If you have service needs related to any Calgon Carbon system, technology, or equipment, we will handle them for you.

All Calgon Carbon products, systems, and technologies are available on a laboratory, pilot plant, or full-scale production basis. Each customer is provided with customized process

engineering design to ensure that the manufacturing process meets their specific requirements. Full analytical laboratory support is also available including computer modeling to demonstrate product performance and quality.



www.calgoncarbon.com



CALGON CARBON CORPORATION

Calgon Carbon Asia
65 Chulia Street
#37-03 OCBC Centre
Singapore 049513
Tel: 65 6 221 3500
Fx: 65 6 221 3554

Calgon Carbon Corporation
UV Technologies Division
P.O. Box 717
Pittsburgh, PA USA 15230-0717
1-800-422-7266
Tel: 412-787-6700
Fx: 412-787-6713

European Operations of Calgon
Carbon Corporation
Zoning Industriel C de Feluy
B-7181 Feluy, Belgium
Tel: + 32 (0) 64 51 18 11
Fx: + 32 (0) 64 54 15 91