

Briefing & Case Histories: Photo-Cat Destruction of 1,4-Dioxane

Treatment of 1,4-Dioxane, Chlorinated Organics, Other Chemicals & Metals

Predominantly found in groundwater containing chlorinated organics, **1,4-dioxane** has emerged as a significant contaminant of concern. Removal of the contaminant is being increasingly mandated by new legislations. Existing treatments such as activated carbon, air stripping, and biological processes do not remove 1,4-dioxane. Chemical based Advanced Oxidation Processes (AOPs) can treat 1,4-dioxane; however, they suffer from disadvantages such as vulnerability to low UVT, durability, chemical safety and efficiency. Photo-Cat offers significant advances over chemical based AOPs.



Photo-Cat, Best Available Technology AOP+

Photo-Cat destroys 1,4-dioxane and other chemical contaminants in water through a **mature, proven, chemical free** photocatalytic process. This process is **not Hydroxyl chemistry based. PLUS** Photo-Cat is able to treat chemical contaminants that conventional AOPs can not: making it an AOP+. This **green** process is fully **automated**, generates no waste stream, has no air emissions or air permits, is **ozone free, peroxide free**, has no **wipers**, eliminates secondary concerns, and has a service interval greater than 18,000 hours. Photo-Cat has demonstrated **one third the lifecycle cost** of chemical based AOP technologies, making Photo-Cat the cost effective choice. Just add power.

1,4-Dioxane Destruction Using Photo-Cat

Photo-Cat is a modular, turn-key system. It is easy to operate, safe, and provides the **best available technology** for the destruction of chemical contaminants. It is easily integrated with existing equipment, and has a small footprint. The built in controls has the ability to control the entire operation with online diagnostics, data logging and remote interface. Photo-Cat is **chemical free**.

Metals Removal

The CFFeR (Chemical Free Fe Removal) is a technology that can be integrated with Photo-Cat for iron, manganese, arsenic and certain other metals removal in water. This technology collects metals of concern as a metal oxide and not as a precipitate to levels below the detection limit. CFFeR **eliminates** the need for clarifiers, sludge thickening, filter presses, pH control equipment/chemicals and costly metals disposal requirements.

Photo-Cat Availability & Cost Structure

Pilot and full scale Photo-Cat solutions are available in capacities from 1 to Multi-Million gallon/day capacity. Photo-Cat systems are operable upon arrival on site. Therefore CAPX is based on the enclosure and Photo-Cat equipment only and OPEX is based on kWhrs per volume treated and an 18,000 hr service interval.

Briefing & Case Histories: Photo-Cat Destruction of 1,4-Dioxane

Case Studies Including Detail on Case 2 Incorporating Fe & Mn Removal _____

Case 1 **Brownfield, Ontario**



Influent = 1500 ppb
Effluent = <3 ppb

Case 2 **Municipal, North Carolina**



Influent = 2130 ppb
Effluent = <2 ppb

Details below

Case 3 **EPA Site, New Hampshire**



Influent = 300 ppb
Effluent = <3 ppb

Case 4 **Industrial, Tallavast, FL**



Influent = 990 ppb
Effluent = <3 ppb @ 120 ppm chlorides

Case 5 **Industrial, Florida**



Influent = 170 ppb
Effluent = <1 ppb

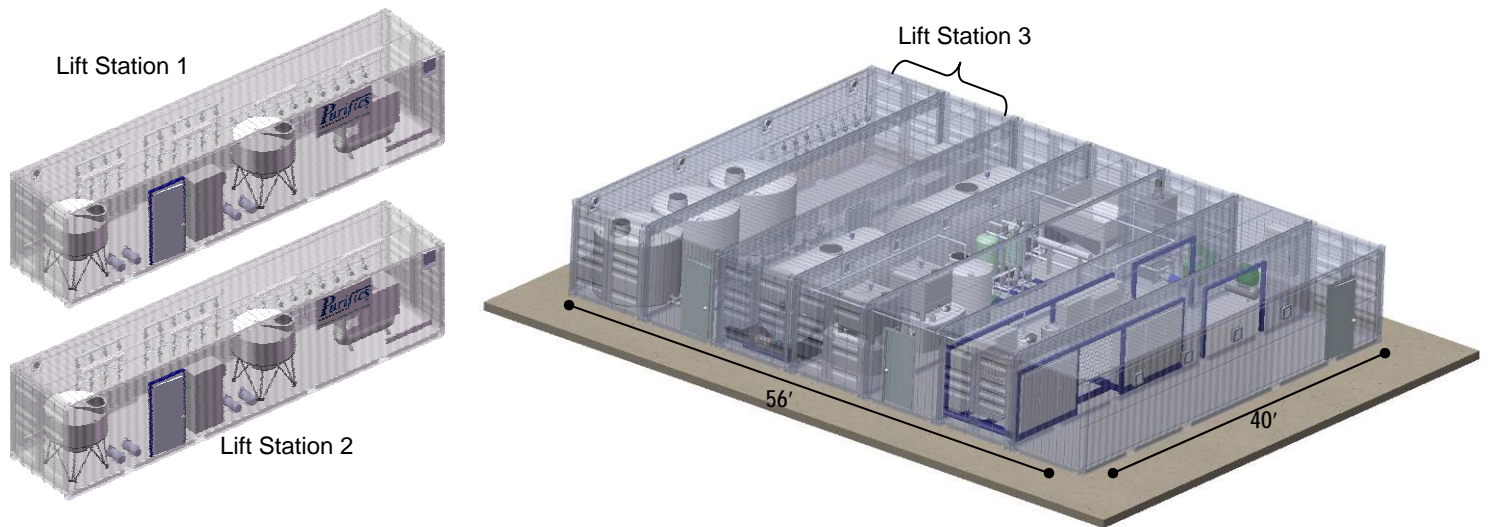
Case 6 **Grace Superfund Site, Mass.**



Influent = 25 ppb
Effluent = <1 ppb

Next Generation Technology.
Operational March 2011.

Case History 2: Ground Water & Leachate Treatment for 1,4-Dioxane



Packaged Solution – In Production, Operational April 2011

- Photo-Cat is the selected technology with complete plant design
- Fully automated & integrated system demonstrated at pilot level; no filter consumption
- UL Certified and PE Stamped Drawings
- Effective metals removal
- No Hydrogen Peroxide, No Ozone, No Carbon, No Clarifier
- **Significant life cycle cost reduction**
- Reuse - Treated water used for Irrigation



Challenge

- Complex ground water from a former Waste Recovery Facility with 10% leachate
- Water contains DNAPL, VOCs, 1,4-dioxane, Metals
- 6 ppm Fe and 8 ppm Mn to be removed
- Thirteen wells to be pumped; Total flow 190 L/min (50 gpm)

Site Background

- Previously tested unit operations; including ChemOx (O_3/H_2O_2), air stripper, and metals precipitation.



Advanced Solution & Integration Demonstration

- Integrated Photo-Cat solution with well control, oxidized metals removal, air stripper, lift stations, and Photocatalytic AOP⁺

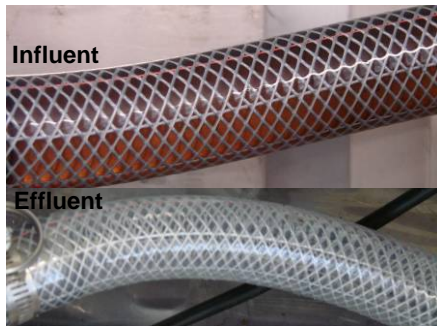
Pilot Equipment



Water Quality: Influent & Post Photo-Cat

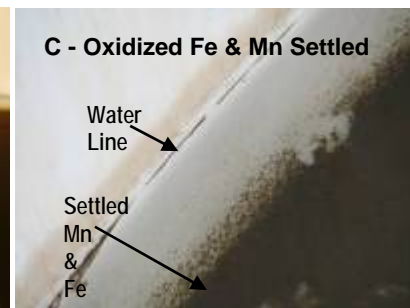
Parameter	Influent	Effluent
1,1,1-Trichloroethane	935 ug/L	ND
1,1-Dichloroethane	1990 ug/L	ND
1,1-Dichloroethene	745 ug/L	ND
1,2-Dichloroethane	95.3 ug/L	ND
Benzene	88.1 ug/L	ND
Chlorobenzene	3210 ug/L	ND
Chloroethane	445 ug/L	ND
Cis-1,2-Dichloroethene	3880 ug/L	ND

Parameter	Influent	Effluent
Methylene Chloride	2540 ug/L	ND
Toluene	188 ug/L	ND
Vinyl Chloride	508 ug/L	ND
Xylene	75.1 ug/L	ND
1,4-Dioxane	2130 ug/L	ND
Fe	5900 ug/L	ND
Mn	8300 ug/L	ND
TOC	21030 ug/L	NA



Iron & Mn Removal

Photo A shows only Fe oxidation. Photo B shows Fe & Mn oxidation. Photo C shows how easily the oxidized Fe & Mn settle out. The concentrate is oxidized as opposed to precipitate. It has a lower volume, is more dense and is easy to decant. No hydroxides produced or present (analysis to confirm non hazardous waste).



Purifics
ES Inc.

340 Sovereign Road, London, ON, Canada, N6M 1A8
Ph: 519.473.5788, info@Purifics.com, www.Purifics.com

Purifics products are protected by one or more of the following US Patents: #5,462,674 / #5,554,300 / #5,589,078 / #6,136,203 / #6,215,126B1 / #6,398,971B1 / #7,008,473B2 / #7,326,278B2 / #7,425,272B2 / #7,588,688B2.

Other domestic and foreign patents are pending. Purifics, Photo-Cat & AOP⁺ are registered trademarks