TPH & Volatile Treatment Technology

- **OXYTEK™S (solid):** a proprietary patent pending blend of nutrients and oxidizers used for soil and groundwater contamination.
- **OXYTEK™L (liquid):** a proprietary patent pending stablized oxidizer used for waste water detoxification and in-situ soil remediation.
- **OXYTEK™S and L** safely remediate **hydrocarbons, chlorinated solvents**, **herbicides/pesticides, PCP/Dioxins** and **PCB's** in-situ and ex-situ**.**
- **OXYTEK S and L** eliminate waste water and hydrocarbon odors upon contact.

OXYTEK S /L

FEATURES/BENEFITS

- *Low treatment cost w/Proven effectiveness*
- *Easy to apply*
- *Can be used with limestone soils*
- *Not exothermic/Controlled oxidation*
- *Fast remediation/detoxification time*
- *Regulator supported technology*
- *Safe to use and Controls air/odor emissions*

OXYTEK ™ *Applications*

- ***Refineries***
- ***Wood Treating Sites***
- ***Tank Farms***
- ***MGP Sites***
- ***Industrial Sites***
- ***Utility Sites***
- ***Under Buildings/Basements***
- ***Low Permeability Soils***
- ***Railroad***
- ***Concrete***

OXYTEK ™ L *Applications*

- ***Lift Stations***
- ***Food Plant Waste Water***
- ***Grease Traps***
- ***Sludge Volume Reduction***
- ***Sewer Odor Control***
- ***Meat Slaughter Houses***
- ***Oxidation Ponds***

Fenton's Chemistry

- The chemistry of Fenton's Reagent (1) is well documented for producing hydroxyl radicals by the reaction of hydrogen peroxide and ferrous iron (Fe+2). The hydroxyl radicals (OH•) serve as very powerful, effective, and nonspecific oxidizing agents, second only to fluorine in oxidizing power.
- $H_2O_2 + Fe^{+2} \rightarrow Fe^{+3} + OH^- + OH\bullet$

Modified Fenton's Chemistry

- The Modified Fenton's chemistry is also defined
- $H_2O_2 + Fe^{+2} \rightarrow Fe^{+3} + OH^- + OH\bullet$
- $2CaO_2 + 2H^+ \rightarrow Ca^{2+}(aq) + 2\ H_2O_2$
- $H_2O_2 + OH^- \rightarrow H_2O + HOO^-$
- $2\ H_2O_2 \rightarrow 2H_2O + O_2$

Advantages of Modified Fenton's Chemistry (OXYTEK)

- Oxytek maintains ideal conditions which allows the H2O2 can completely oxidize certain chlorinated hydrocarbons *in situ*, including those commonly found at chlorinated solvent and PCB sites without the production of toxic daughter products.

- H2O2 can be used to treat contaminate sources within both the saturated and unsaturated zones.

- Rapid reaction times and high destruction efficiencies can be achieved with H2O2 leading to significant concentration reductions at source areas and reduced remediation costs over the life of the project.

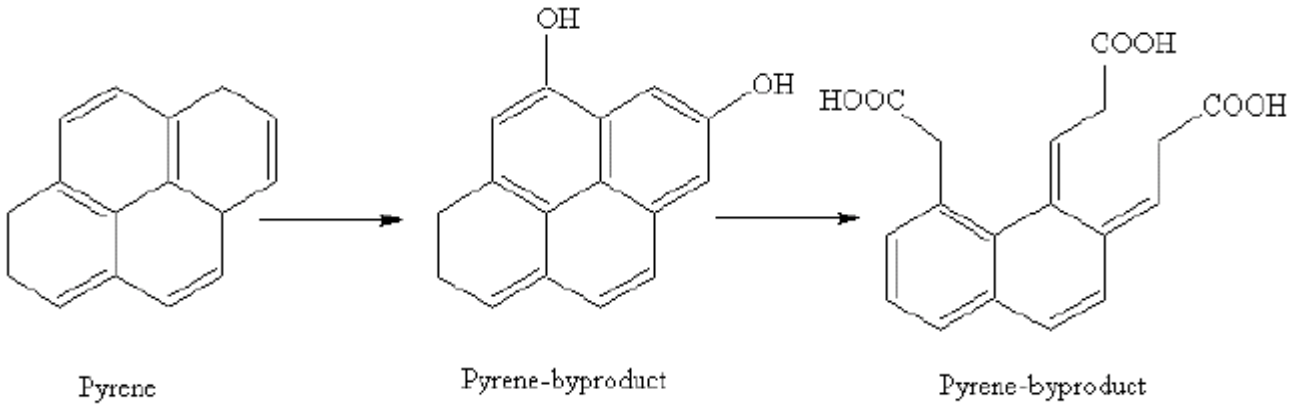
Advantages of Modified Fenton's Chemistry (OXYTEK)

- Since H2O2 degrades rapidly in the environment, excess oxidant in the subsurface does not represent an environmental impact.

- The contaminates are treated *in situ* and are converted to innocuous and/or natural occurring compounds like water, carbon dioxide, oxygen, simple acids and alcohols and halides.

- Oxytek is formulated so that its oxidation reaction occurs at neutral pH of 6.5 to 7.5 instead of the extreme acidic pH required for Fenton's reaction which allows for safe handling and no substrate limitations.

Decomposition Pathway of Pyrene via Modified Fenton's Chemistry (OXYTEK)



Note that the second by-product is hydroxylated which makes the molecule more water soluble and the next by-product has the ring structures breaking open and starting to form simple acids and simple alcohols which also promote dissolution of additional PAH's. The molecule will continue to degrade until it is CO2, water, and oxygen is all that remains.

Decomposition Pathway For Chlorinated Compounds

- PCE
- $C_2HCl_3 + Fe^{+2} + 2H_2O_2 \rightarrow Fe^{+3} + 4Cl^- + 2CO_2 + 2H_2O$
- TCE
- $C_2HCl_3 + Fe^{+2} + 2H_2O_2 \rightarrow Fe^{+3} + 3Cl^- + 2CO_2 + H^+ + 2H_2O$
- MTBE
- $C_5H_{12}O + 15H_2O_2 \rightarrow 5CO_2 + 21H_2O$

Concentrations (in mg/kg) of petroleum hydrocarbon fractions considered by CCME [*1*] after 10 days and 20 days compared with the required treatment levels.

Scenario	F1 (C_6-C_{10})	F2 (C_{11}-C_{16})	F3 (C_{17}-C_{34})	F4 (>C_{34})	Total
10-day					
Untreated	3,855	7,282	8,995	1,285	21,417
1.4 kg/m^3	**761**	**3425**	**4482**	**1074**	**9,742**
2.9 kg/m^3	**294**	**1,142**	**1,256**	**991**	**3,683**
AE 2001a*	260	900	800	5600	7,560
20-day					
Untreated	4,328	7,088	8,785	1,589	21,790
1.4 kg/m^3	**510**	**2402**	**3125**	**952**	**6,989**
2.9 kg/m^3	**113**	**521**	**685**	**1010**	**2,329**
AE 2001a*	260	900	800	5600	7,560
30-day					
Untreated	3,697	8,752	6,442	1,301	20,192
1.4 kg/m^3	**450**	**2108**	**1505**	**808**	**5,871**
2.9 kg/m^3	**75**	**479**	**598**	**876**	**2,028**
AE 2001a*	260	900	800	5600	7,560

PCB Concentrations in Core Layers Before and After OxyTek-S Treatment - Building 1

Sample No Building 1	Approx. Location in Thickness	Material Type	Approx. Core	Material Thickness	Range Tested	Approx. Layer	PCB Concentration ppm
CS-PRE-C1-01		concrete		0 to 4.1 cm			**742**
CS-PRE-C1-02				4.1 to 9.2 cm			**963**
CS-PRE-C1-03				9.2 to 13.7 cm			**272**
CS-PRE-C1-04				13.7 to 18.0 cm			**51.8**
CS-PRE-C1-05				18.0 to 22.4 cm			15
CS-PRE-C1-06				22.4 to 26.3 cm			14.2

Sample No	Approx. Location in Building 1 Material Type	Approx. Layer Thickness		PCB Concentration ppm
CS-T2-01		0 to 2.4 cm	2.4 (top)	0.50
CS-T2-02		2.4 to 4.2 cm		0.32
CS-T2-03		4.2 to 6.1 cm		0.14
CS-T2-04		6.1 to 7.6 cm		<.05
CS-T2-05	**Concrete**	7.6 to 9.6 cm		<.05
CS-T2-06		9.6 to 11.7 cm		<.05

Lindane Degradation

Sample	Average Conc. of Total HCH*
Background (t=0)	7,367 mg/kg
3 lbs/yd^3 (t=10 days)	2,205 mg/kg (70%**)
5 lbs/yd^3 (t=10 days)	66 mg/kg (99.1%**)

BTEX Treatability Results
4 Days

BTEX

Lab Number		**S2006-00464**	**S2006-00465**	**S2006-00466**	**S2006-00467**	**Lab**
Sample ID		**A**	**B**	**C**	**D**	**Blank**
Date Collected		**17-Jan-06**	**17-Jan-06**	**17-Jan-06**	**17-Jan-06**	
Unit		**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**
Parameters	**MDL* (µg/L)**	**OXYTEK Treat 1**	**OXYTEK Treat 2**	**OXYTEK Treat 3**	**Control**	
Benzene	0.6	110	<0.6	<0.6	2330	<0.6
Toluene	0.7	235	<0.7	2.9	4580	<0.7
Ethylbenzene	0.8	127	0.9	1.0	629	<0.8
m/p-Xylene	1.3	770	16.8	6.8	4960	<1.3
o-Xylene	0.8	435	11.2	5.6	2270	<0.8
Dilution Factor		10	1	1	50	1
BTEX Surrogate Recovery						
1,4-Difluorobenzene (%)		96	134	101	85	82
4-Bromofluorobenzene (%)		112	132	109	104	93

Food Plant Waste Water

- A large pizza manufacturer in the Mid-Western U.S. has for many years been land applying their waste water sludge to local farms. Due to the ever increasing levels of contamination from the sludge applications and new land application limits have eliminated this choice for disposal. The sludge is high in Fats, Oil and Grease (FOG) and greatly exceeds current sanitary sewer limits and can not be disposed of into the local sewer. The plant is currently generating 20,000 gallons of sludge per week or approximately 4,000 gallons per day.

Process

- The waste water sludge is collected in a vertical 20,000 gallon tank at the plant. Adjacent to the 20,000 tank is another 6,000 gallon overflow tank which was utilized as a reaction vessel for digesting the sludge with liquid OXYTEK™. Each daily accumulation (4,000 gallons) is digested with liquid OXYTEK for one hour in the overflow tank and then pumped into the 20,000 gallons collection tank. The OXYTEK digestion reduces the FOG's to 125 ppm or less and knocks out the water in the sludge. The treated mixture is then put through a small mobile sand filter unit at the end of each week and filters out any remaining solids and the water now meets city sewer limits and is discharged into the city sewer system at the plant. The digested solids that are filtered out amount to less than a 55 gallon drum of material and it is dried and disposed of at the local landfill.

Results

- **FOG's (ppm)** Untreated 598 Treated 125 80% Reduction