APTwater
Clean Water. No Waste.®

PulseOx® Overview

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Up to 1 Billion Times Faster. No Extra Charge.

PulseOx® APTwater's PulseOx® process is an in-situ chemical oxidation (ISCO) technology for the remediation of contaminated soil and groundwater. PulseOx systems offer 35-50% more powerful chemical oxidation, and up to 1-billion times faster reaction kinetics than conventional air-sparge or ozone-sparge remediation systems. PulseOx systems deliver greater value through faster cleanup and closure of environmental remediation sites.

The PulseOx system is based on patented ozone + hydrogen peroxide sparge technology that produces Advanced Oxidation Process (AOP) chemistry directly in the subsurface. This powerful hydroxyl radical oxidation chemistry rapidly oxidizes a wide range of groundwater contaminants. One powerful beneýt of the PulseOx AOP reaction is a tremendous increase in groundwater dissolved oxygen (DO) content which promotes natural attenuation across the site. The aggressive injection process enables rapid clean-up of highly contaminated "hot-spots" or the effective development of contaminant barriers or "sparge curtains."

PulseOx systems are available in a range of standardized sizes to suit a wide range of application needs. The self-contained and fully-automated systems allow for rapid deployment and easy operation.

The PulseOx system operates by injecting a sequence of pressurized 'pulses' of ozone, hydrogen peroxide, oxygen, and air directly into the subsurface. The injection sequence, timing, and proportions can be fully customized to assure that all chemicals and hydroxyl radicals are thoroughly distributed in the zone of contamination.

The entire PulseOx process is fully-automated. Injection intervals and volumes are set based on patented process chemistry that is customized to the type of contamination and actual site conditions. All systems are provided with full instrumentation for remote monitoring of all critical process parameters and to assure the highest level of safety. Once started, the system can provide fully-unattended remediation to increase productivity and signiýcantly reduce treatment cost.

System Features

PulseOx systems are provided with a number of features and advantages to best match the site conditions, contaminant and oxidant demand, including:

- Å Range of standardized system sizes and conýgurations
- Å Fully automated PLC controlled operation
- Å Unattended 24/7/365 operating capability
- Å Fully enclosed and self-contained trailer-mounted units (most systems)
- Å Standardized electrical and hydraulic connections
- Å Integrated oxygen and ozone generators (most systems)
- Å Integrated instrumentation, controls, and alarms
- Å Low maintenance
- Å Proven reliability at over 120 installations

Applications

The PulseOx process is ideal for the in-situ remediation of a wide range of dissolved contaminants, including:

- Å Petroleum Hydrocarbons (BTEX, TPHg, Diesel, Aviation Fuel, etc.)
- Å Chlorinated Solvents (PCE, TCE, DCE, VC, and most intermediaries)
- Å Solvent Stabilizers (1,4-dioxane)
- Å Fuel Oxygenates and Byproducts (MTBE, TBA, etc.)
- Å PAHs (naphthalene and other aromatic compounds)
- Å Creosols / Phenols (creosote and many phenolic compounds)
- Å NAPL destruction in source areas or vadose zone soils
- Å Other Organics (naturally occurring organic materials, tannins, etc.)

Advantages & Beneýts

PulseOx process systems offer a number of operating advantages as compared to other in-situ remediation technologies:

- Å **Powerful Hydroxyl Radical Chemistry**
- Å **No Process Residuals**
- Å **Rapid Clean-up: 6-12 months typical**
- Å **Fast & Easy Deployment**
- Å **Easy Integrations with Other Processes**
- Å **Fully-Automated 24-7-365 Operation**
- Å **Process Safety**
- Å **Cost-Effectiveness**

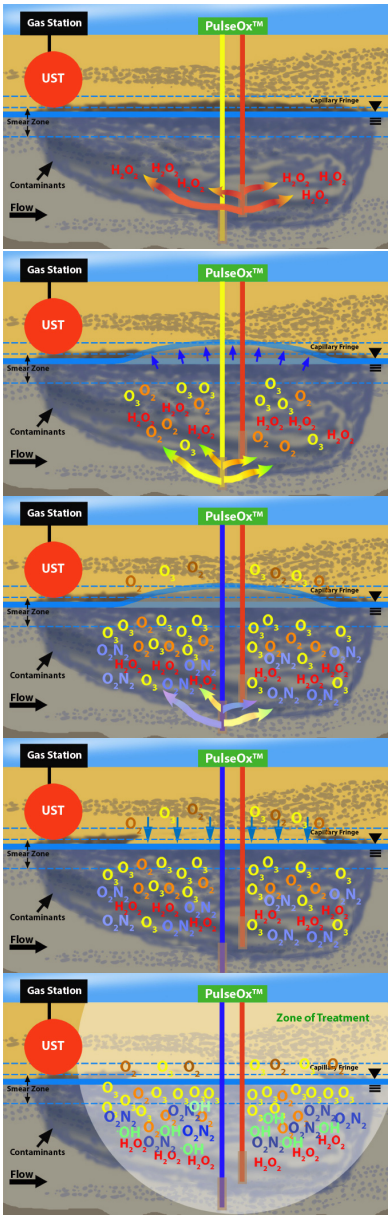
How It Works

The PulseOx process is implemented through a series of fully-automated steps, as follows:

Step 1
Injection of aqueous H_2O_2.

Step 2
Injection of gaseous O_3 and O_2.

Step 3
Injection of high-pressure O_2 and / or air assures complete chemical dispersion throughout the subsurface. Mounding of groundwater around the injection point provides "scrubbing" of the vadose zone.

Step 4
AOP reaction produces OHÅ radicals that instantaneously oxidize and destroy contaminants.

Step 5
Residual oxygen from the AOP process dissolves into groundwater down gradient of the treatment zone, thereby facilitating oxidation and aerobic biodegradation of contaminants in an even wider zone of inþuence/treatment.