



iSOC[®] YOUR ULTIMATE MANAGED ATTENUATION TOOL

iSOC[®] UPDATES

iSOC[®] has rapidly become the most popular bioremediation tool for remediating a wide range of contaminants, including recalcitrant compounds in groundwater. iSOC[®] has been used at hundreds of sites for effective remediation of a wide range of contaminants including hydrocarbons and chlorinated hydrocarbons in any lithology. iSOC[®] requires no electricity which leads to extremely low O&M compared with competing technologies.

A New Application of iSOC[®] Technology: Chlorinated Sites

Recently, iSOC[®] technology has been applied to sites contaminated with chlorinated hydrocarbons using oxygen and other gases to treat chlorinated sites under both anaerobic and aerobic conditions. Our website has been updated to reflect these bioremediation alternatives and various processes and soon our microcosm studies will provide more information to optimize delivery of combinations of gases to best stimulate the biological degradation of harmful substances.

A Micro-sized Control Panel

iSOC[®] is often used in individual wells with a small access box covering the well. While this set-up is cost-efficient and convenient, requiring no major site disruption or costly installation, the size of the access box is very limiting. Using innovative technology originally developed by NASA and successfully proven on our other Gas inFusion devices, we developed a small gas flow control device to sit in the top of the iSOC[®] unit. The result is a much simpler and easier installation that benefits the consultant and site owner both.

iSOC[®] AND BIOREMEDIATION ENHANCEMENT

iSOC[®] is an ingenious gas delivery system based on inVentures' patented Gas inFusion technology - a unique method of infusing supersaturated levels of dissolved gas into liquids. At the heart of iSOC[®], the proprietary structured polymer mass transfer device is filled with micro-porous hollow fiber that provides an enormous surface area for mass transfer - in excess of 7000 m²/m³. It is hydrophobic and therefore excludes water. Maintaining gas pressure less than the surrounding liquid pressure ensures that ultra efficient mass transfer takes place without sparging.

In an aerobic bioremediation application, the iSOC[®] supersaturates the monitoring well with low decay dissolved oxygen (DO), typically 40-200 PPM depending on depth in groundwater. A natural convection current and a designed release bubble from the top of the iSOC[®] fills the well with a uniform DO curtain. The supersaturated DO curtain of water disperses around the well into the adjacent groundwater and enhanced bioremediation removes organics through natural attenuation. Placement of injection wells depends on site-specific conditions. The system is installed in a few hours and easily moved from well to well to optimize performance and remediation strategies.

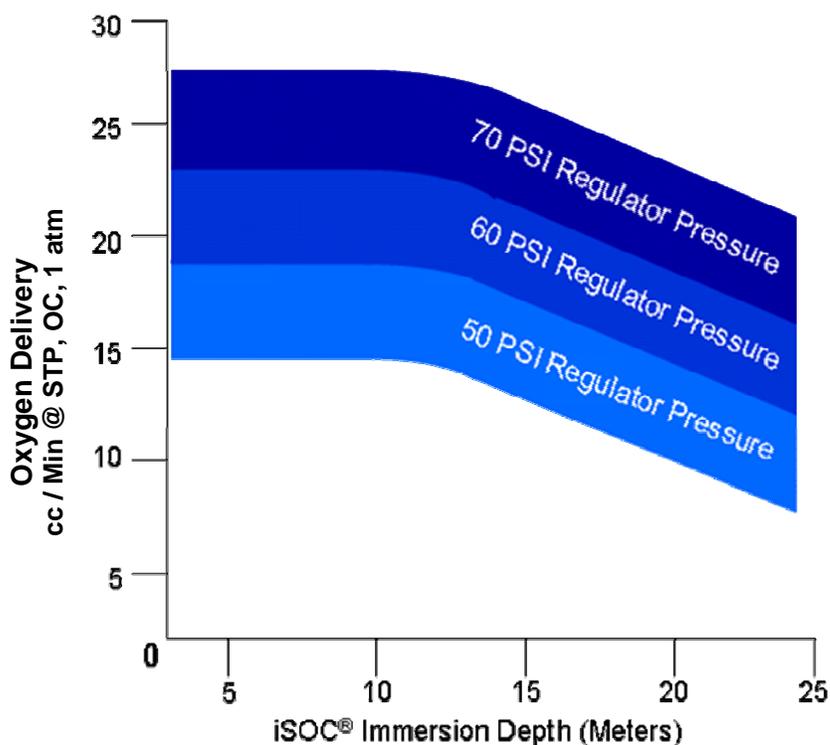


iSOC[®] ADVANTAGES

- Accelerates site closure through enhanced natural attenuation as a primary remediation strategy or as a polisher
- Delivers 40 to 200 PPM DO depending on iSOC[®] depth.
- Installs in existing 2-inch (50mm) monitoring wells.
- Application not limited by iron fouling under most conditions.
- Connects to standard gas cylinder.
- No power requirements, off-gases, pumps, or hazardous by-products.
- Small, simple, efficient, predictable, easy to use, & very low O&M.

MICRO-SIZING THE iSOC[®] CONTROL PANEL

In an effort to make the iSOC[®] System as easy to deploy as possible, the iSOC[®] Control Panel which determined the gas flow to the iSOC[®] and its structured polymer mass transfer device has been micro-sized. It now sits within the top of the iSOC[®] device and automatically controls the gas flow depending on groundwater depth and pressure regulator setting. All the installer has to do is set the pressure on the two-stage regulator. The iSOC[®] is simply attached to the tubing from the iSOC[®] Distribution Header and lowered into the well. There is no longer any need to house and mount a bulky control panel. The micro-sized flow controller is based upon valve control technology initially used in the NASA Space program and currently used on other Gas inFusion Technology applications.



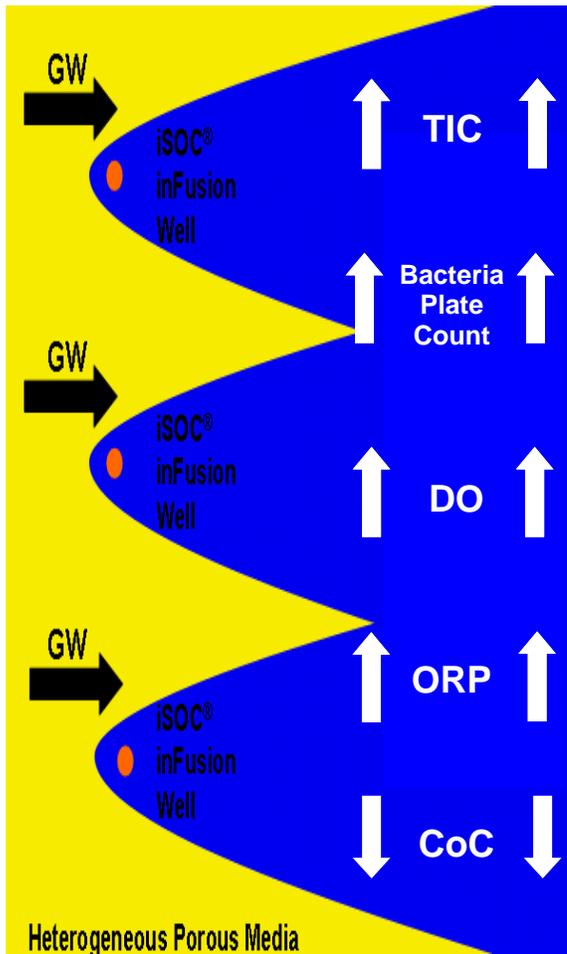
MICRO-FLOW CONTROLLER

The built-in flow controller delivers a range of oxygen flow to the mass transfer device within the iSOC[®] depending on the immersion depth in groundwater and the pressure regulator setting. For immersion depths of less than 60 feet (18.3 m) of water, it is recommended that the oxygen regulator be set at 50 psi (3.4 bar). This will result in an average of 15 standard cc/min of oxygen delivered to the groundwater by the iSOC[®]. For greater depths, the regulator setting should be adjusted such that it is a minimum of 25 psi (1.7 bar) above the head pressure of the water.

WHERE HAS iSOC[®] BEEN USED?

The iSOC[®] technology has been used at hundreds of sites in the US, Canada, UK, Europe and Africa. It is currently being piloted on sites in Australasia and Japan. The technology has been deployed to bioremediate a range of hydrocarbons and other chemicals using direct aerobic, cometabolic, and anaerobic degradation methods.

iSOC® CONES OF INFLUENCE BASED ON FEMLAB MODEL



iSOC® REMEDIATION APPROACH

- Create an oxygen / bio barrier at the leading edge of the contaminant plume to avoid boundary litigation and to protect off-site receptors.
- Reduce contamination levels by source treatment with supersaturated oxygen at the heart of the plume.
- Achieve rapid, localized remediation of low-level contamination and hot spots in existing monitoring wells.
- Accelerate site closure through natural attenuation as a primary remediation strategy or as a polisher.
- Lowest annual O&M cost of any passive enhancement technology.

HYDROCARBONS AND iSOC®

The use of dissolved oxygen in hydrocarbon contaminated groundwater to enhance natural attenuation of hydrocarbons such as MTBE and BTEX has been growing as a remediation technology since the mid-1990s. Conventional sparging technologies typically waste most of their delivered oxygen. Sparging bubbles make preferential flow paths and rise to the top of the groundwater table, escaping before they have a chance to dissolve and be utilized by naturally occurring hydrocarbon-degrading micro-organisms. Other in-situ technologies generate oxygen for a short period of time but are inadequate in aquifers with high ferrous iron, moderate BOD, and/or high concentrations of hydrocarbon constituents. iSOC® is a proven bioremediation technology that delivers high concentrations of dissolved oxygen into the aquifer. Very low O&M costs allow the iSOC® technology to be deployed in all types of remediation projects and site conditions.

iSOC® RADIUS OF INFLUENCE

Case studies and field measurements have shown the typical iSOC® radius of influence to be 10 feet (3 m) to 20 feet (6 m) laterally from the infusion well and many more feet in the direction of groundwater flow. Flowing groundwater and molecular diffusion transport the dissolved gas (e.g. oxygen, alkane, hydrogen) to the saturated porous media. The higher the concentration in the infusion well, the further the transport of the gas and the greater the influence. The influence is best measured by biological parameters, as the measure of dissolved gases at a distance from the infusion well is often inconclusive.

TYPICAL GAS CONCENTRATIONS (ppm)

GAS TYPE	WATER COLUMN DEPTH (ft/m)				
	5'/1.5	10'/3	15'/4.6	20'/6.1	50'/15.2
Oxygen	42	55	62	69	111
Methane	22	30	33	37	59
Propane	66	88	99	110	175
Hydrogen	2	2	3	3	5
Ethane	57	75	85	95	150

USING OTHER GASES WITH iSOC®

Consultants may need to use gases other than oxygen in their remediation approach. For example, hydrogen, methane, or propane may be used for remediation of chlorinated solvents and perchlorate. iSOC® will transfer these gases into the groundwater as effectively as it transfers oxygen, as shown above.



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iSOC[®] DISTRIBUTION HEADER

Each order is supplied with a distribution header. Multiple port distribution headers are available. The size ordered is determined by the number of iSOC[®] units being run from each regulator. The distribution header can be directly mounted onto the gas regulator. The header is supplied with an on/off valve for each iSOC[®] unit such that the gas bottles can be changed without pulling the iSOC[®] from the well. For further detail go to www.isocinfo.com — Installation and Design — Installation Procedures.

iSOC[®] QUALITY CONSTRUCTION

iSOC[®] is constructed of high quality SS316 stainless steel using the latest manufacturing equipment and a proprietary structured polymer mass transfer device. iSOC[®] is 1.62" (41 mm) in diameter and 12.65" (321 mm) long with a barb connector for 0.17" (4 mm) ID polyurethane tubing. The housings for the pressure and flow control unit and the drain plug are made from nylon. iSOC[®] has a lifting ring for connecting to a suspension line for insertion in 2" (50 mm) or larger monitoring wells.

iSOC[®] COSTS

The iSOC[®] groundwater remediation technology is the leading and most cost effective solution in the marketplace today. Speak with your local iSOC[®] Sales Representative for system pricing. Your nearest Sales Representative can be found at www.isocinfo.com. For technical assistance please email support@inventures.ca.

CHLORINATED SOLVENTS AND iSOC[®]

The iSOC[®] Gas inFusion system is used to effectively remediate chlorinated solvent contaminated groundwater. Where tetrachloroethene (PCE) is the main contaminant of concern, a two-stage sequential bioremediation approach is used to first degrade PCE to trichloroethene (TCE) by reductive dechlorination, followed by aerobic cometabolic oxidation of TCE and other daughter products such as DCE and vinyl chloride. Alkane gas delivered by iSOC[®] stimulates the anaerobic process. iSOC[®]s are used to deliver oxygen and additional alkane gas to achieve aerobic cometabolic treatment of the daughter products. The aerobic process can be applied independently to TCE, DCE and VC sites and is not subject to stall due to competing electron acceptors or limited availability of necessary anaerobic microorganisms. Several alternative bioremediation approaches can also be implemented with iSOC[®]s including direct aerobic treatment of vinyl chloride and reductive dechlorination of chlorinated solvents by direct hydrogen delivery.

SYSTEM SET-UP

