In-Situ Inc.
Innovations in Water Monitoring
Technical Note

Bioremediation Applications

February 2010

Use of the TROLL® 9500 Instrument in In-Situ Chemical Oxidation (ISCO) Remediation Projects

Introduction

In-Situ chemical oxidation (ISCO) is a remediation procedure in which strong oxidizing chemicals are used to destroy toxic organic chemicals. The Interstate Technology and Regulatory Council (2005) lists contaminants which can be removed via ISCO techniques. These include:

- Benzene, toluene, ethylbenzene, and xylenes (BTEX)
- Methyl tert-butyl ether (MTBE)
- Total petroleum hydrocarbons (TPH)
- Chlorinated solvents (ethenes and ethanes)
- Polyaromatic hydrocarbons (PAHs)
- Polychlorinated biphenyls (PCBs)
- Chlorinated benzenes (CBs)
- Phenols
- Organic pesticides (insecticides and herbicides) and munitions constituents (RDX, TNT, HMX, etc.)

According to the EPA (2000), a successful remediation project is based on matching the oxidant and the in-situ delivery system to the contaminants of concern and the site conditions. The most commonly used oxidants in ISCO remediation include (ASCE, 2007):

- Permanganate
- Sodium Persulfate
- Hydrogen peroxide
- Ozone

According to the ITRC (2005), there are two monitoring phases conducted at remedial sites:

- **Process and Performance Monitoring** are conducted during the remediation activity. Parameters are monitored on a frequent schedule to track the distribution of the oxidant, the movement of the contaminant plume, and the movement and concentration of oxidation by-products
- **Post-treatment and Closure Monitoring** are conducted after the remediation activities have ceased and are conducted to verify the success of the remediation.

Additionally, baseline groundwater conditions at the site must also be established for parameters such as the contaminant, potential by-products of the treatment, metals, and key parameters such as pH, ORP, and dissolved oxygen (DO) (ITRC, 2005).

Parameters frequently measured during ISCO process and performance monitoring that are supported by the TROLL 9500 water quality instrument include:

- ORP Measurement, Standard Methods 2580
- pH, Continuous Monitoring (Electrometric), EPA 150.2
- Temperature, EPA 170.1
- Specific conductance, EPA 120.1
- Dissolved oxygen, Alternate Test Procedure N05-0014 In-Situ Method 1002-8-2009 DO Measurement by Optical Probe (RDO®)
- Pressure/level

Temperature, pH, and pressure are frequently measured at the injection well site, while pH, temperature, ORP, DO, and conductivity are frequently measured at monitoring well locations (ITRC, 2005).

These water quality parameters help groundwater hydrologists track the progress of the remediation. Importance of the various parameters has been described by ITRC (2005):

- pH—Baseline values help to determine which oxidant to use, its expected efficacy, and any amendments to pH that must be considered.
- ORP—Changes to ORP values can help track oxidant movement throughout the plume.
- DO—Low concentrations reflect increased contaminant levels; increasing levels indicate oxidant movement.
- Temperature—Increases after H_2O_2 injection. Monitored for safety purposes.
- Conductivity—Small increases can indicate oxidant movement into a contaminated area.

Equipment Required

- TROLL® 9500 Professional water quality instruments with sub-2" RDO® optical DO sensor, pH/ORP, conductivity, and built-in temperature, and barometric sensors. Onboard turbidity and level/pressure are available in a sub-2" configuration with Clark cell DO only or with optical DO in a sub-4" configuration.
- Vented Tefzel® RuggedCable® system from 6' to 4000'
- Well dock and well cap (locking or non-locking)
- Desiccant for vented RuggedCable systems.
- TROLL® Com USB for use laptop or TROLL Com RS232 for use with RuggedReader® handheld PC
- PC (laptop) or RuggedReader handheld PC

Figure 1. TROLL 9500 instrument, sub-2" with pH, conductivity, optical DO, temperature and barometric pressure.

Program the TROLL 9500 Instrument

1. Use Pocket-Situ® 4 software on a RuggedReader handheld PC or Win-Situ® 4 software on a PC.
2. Connect the TROLL Com device to the PC and launch Pocket-Situ 4 or Win-Situ 4 software.
3. Synchronize the TROLL 9500 clock to the PC.
4. Program an internal data test using the Tests branch in the navigation tree. Define the parameters, the units of measurement, ***and the logging rate.***
5. Define the log with a scheduled start time.
6. Disconnect the TROLL Com device from the PC.

Instrument Deployment

1. Attach the TROLL 9500 to a RuggedCable and deploy at an appropriate depth to measure all the required parameters throughout the duration of the treatment.
2. When measuring pressure, attach the TROLL 9500 instruments on vented, submersible twist-lock cables. When measuring water quality parameters only, a non-vented cable may be used.
3. Suspend the cable from a well dock and use a cap to cover the well.

Figure 1. Vented sub-2" TROLL 9500 with pH, temperature, conductivity, and RDO sensor. Attach RuggedReader handheld PC or laptop via TROLL Com when downloading data.

References

1. Interstate Technology & Regulatory Council (ITRC). 2005. Technical and Regulatory Guidance for In-situ Chemical Oxidation of Contaminated Soil and Groundwater, 2nd ed. ISCO-2. Washington, D.C.: Interstate Technology & Regulatory Council, In-situ Chemical Oxidation Team. Available on the Internet at http://www.itrcweb.org.
2. American Society of Civil Engineers (ASCE). 2007. Remediation Technologies for Soils and Groundwater. Reston, VA: American Society of Civil Engineers.
3. U.S. EPA. 2000. In-situ Chemical Oxidation for Remediation of Contaminated Soil and Groundwater. *Ground Water Currents*. 37:1-3.

Additional Reading

1. Biosparging and Air Sparging Using Level TROLL® and TROLL® 9500 Instruments, http://www.in-situ.com/force_download.php?file=858
2. Low-Flow Groundwater Sampling: Using the TROLL 9500 and Flow-Sense Software, http://www.in-situ.com/force_download.php?file=427
3. Using Level TROLL® Instruments in Soil Vapor Extraction Systems, http://www.in-situ.com/force_download.php?file=421

For more information contact In-Situ Inc.

221 East Lincoln Avenue, Fort Collins, CO 80524
1-800-446-7488 (toll-free in U.S. & Canada
1-970-498-1500 (international & domestic)
www.in-situ.com