Successful Self-Activating ISCO/Enhanced Bioremediation for BTEX Remediation: Soil Mixing Brazil Site

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Background/Objectives. A former gas station site Campinas/São Paulo was contaminated by BTEX and acquired by a developer to construct residential condominiums. The project used Provect-OX® in situ chemical oxidant reagent for ISCO/enhanced bioremediation reagent that uses ferric iron (Fe III) as a safe and effective means of activating persulfate. A main reason for selecting this reagent was “ease of use” (the material is supplied as a dry powder containing about 80% sodium persulfate and 20% ferric oxide that can be easily applied via direct mixing. In addition, the technology manages rebound which avoids the need for repeat application (which was not practical for a development project). This is accomplished via the subsequent utilization of sulfate and iron as terminal electron acceptors for facultative reductive processes. Degradation intermediates generated during pollutant oxidation may act as electron shuttles, allowing the reduction of Fe (III) to Fe (II) in the redox cycling of iron. The iron used for persulfate activation brings additional benefits such as: i) does not generate excessive heat/off-gases; and ii) it will not mobilize heavy metals to generate secondary impact issues.

Approach/Activities. In April 2017 contaminated soil was excavated and removed. Approximately 5,000 kg of Provect-OX were mixed directly into the base and side walls of the excavation within an area measuring 170 m^2. The hole was backfilled with cleaned soil and new monitoring wells were installed proximal to the treated areas to monitor the groundwater plume. Performance monitoring consisted of routine analysis for BTEX and various biogeochemical parameters.

Results/Lessons Learned. Benzene represented the main constituent of interest with baseline concentrations varying between 30 and 224 mg/L and the remediation target levels established to site is 272 mg/L. The first sample event performed 30 days after application showed reduction above 70% and 80% at PM-15A and PM-18A, respectively (see table below). Subsequent sample events showed that the remedial objective was achieved. The wells PM-01, Pm-02 and PM-15 remained below the laboratory quantification limit and PM-35 showed a reduction above 85%. Continuous monitoring showed further benzene reduction, and no rebound observed which supports the concept of sustained, long-term bioremediation processes.

This combined remedy provides supplemental treatment mechanisms thereby allowing for more cost-efficient dosing of the product while supporting long-term, sustained, secondary bioremediation processes to manage residuals and prevent contaminant rebound effect.

Table 1 – Historical Concentration of Benzene X Target Levels						
	April/17	**may/17**	**June/17**	**Sept/17**	**April/18**	**Target Levels (µg/L)**
PM-01						
Benzene	**139.60**	<0.90	<0.90	<0.90	<0.90	272.00
Reduction (%)	*Baseline*	>99.4%	>99.4%	>99.4%	>99.4%	
PM-02						
Benzene	**224,20**	<0.90	<0.90	<0.90	<0.90	
Reduction (%)	*Baseline*	>99.6%	>99.6%	>99.6%	>99.6%	
PM-15						
Benzene	**29,91**	<0.90	<0.90	<0.90	<0.90	
Reduction (%)	*Baseline*	>97.0%	>97.0%	>97.0%	>97.0%	
PM-35						
Benzene	**150,60**	105.00	80.83	71.05	21.66	
Reduction (%)	*Baseline*	30.3%	46,3%	52,8%	85,6%	