

# Revisiting a Closed Site: Expedited Treatability Testing and High Pressure Injection of Activated Sodium Persulfate to Move Site toward Closure, Again

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## Abstract:

This presentation reviews a project which has been closed by another consultant prematurely in 1997, and then was reopened by the Los Angeles Regional Water Quality Control Board in 2000.

A 3,000-gallon gasoline underground storage tank in the Charnock Sub-Basin in Los Angeles was removed in November 1993. Various borings and wells were drilled in 1994, and by February 1997 the local regulatory agency granted case closure. However, in January 2000, due to MTBE discoveries in the area, the case was reopened for additional investigation and remediation. A perched zone and a shallow unnamed aquifer of fine grained sands and clays showed impacts from hydrocarbons above regulatory closure levels. An expedited in-situ remedial program was developed to reclose the case. In 2007, soil treatability testing for in-situ chemical oxidation (ISCO) was performed using Fenton's Reagent as well as sodium persulfate with three activators. Contaminant degradation and the potential for solubilizing metals in the subsurface were evaluated.

A one week pilot test in April 2008 was performed using ten closely spaced probe driven injection ports. A little more than 10,000 gallons of treatment chemicals were injected using computer controlled, high-pressure injection equipment. Average soil concentration reductions of TPH-g, BTEX and MTBE were greater than 60%. Average shallow groundwater concentrations in the four nearby groundwater wells showed reductions of over 99% for TPH-g and benzene.

The full scale ISCO injection was done in April 2009 at the subject site. The closely spaced injection matrix used 12 ports. A little over 12,000 gallons of sodium persulfate with iron EDTA Catalyst with no pH adjustment was injected into twelve ports in the treatment zone. Radius of influence studies were performed, showing about a 15-20 foot radius of influence. Variations in field flow data confirmed that the subsurface at the site has anisotropic characteristics or preferred flow pathways. The results of the confirmation sampling and case status will be discussed.

## Expedited Remediation



## Laboratory Data: Before and After

	TPH-g mg/Kg	Benzene mg/Kg	Toluene mg/Kg	Ethylbenzene mg/Kg	Xylenes mg/Kg	MTBE mg/Kg
Average Before Treatment (20-25-30') (CB-1 and CB-2)	109.9	0.1318	6.0837	3.2339	14.1578	0.4333
Average After Treatment (20-25-30') (SCB1, SCB2, and SCB3)	39.9	0.0281	0.1717	0.2957	2.2582	0.000
% REDUCTION	63.7 %	78.7 %	97.2 %	90.9 %	84.5 %	100.0 %

  

	TPH-g µg/L	Benzene µg/L	MTBE µg/L
Average Before Treatment (8 wells; 1/17/08)	70,650	8,360	ND
Average After Treatment (8 wells; 4/25/08)	64	ND	ND
% REDUCTION	99.44 %	100.00%	NA

## Concentrations in Groundwater

**TPH-g Concentrations in Groundwater**  
Two One-week injection events occurred: March 2008 and April 2009. Pre-injection data from January 2008 had TPH-g concentrations for GW1-A and GW4-A at 109,000 ug/L and 32,300 ug/L, respectively. Post injection data from July 2009, shows a decrease after the two injection events of between 90-94% from the pre-injection January 2008 data for TPH-g.

**Benzene Concentrations in Groundwater**  
The pre-injection January 2008 concentrations for GW1-A and GW4-A for benzene were 10,900 ug/L and 5,280 ug/L, respectively. The decrease after the two injection events indicates a 99% reduction from the pre-injection January 2008 data for benzene.

Based on this information, the best available technology was used, and after a 90% reduction in both TPH-g and benzene in the core zone (wells GW1-A and GW4-A), the site should be considered for site closure.

## Concentrations in Soil

**Soil Confirmation Samples**  
The soil confirmation samples indicate that there are heterogeneities in the soil concentrations for TPH-g and benzene. In particular, the high concentration zone at 40 feet below ground surface does exist at soil boring CB1 and from 30-35-40 feet in CB2. As noted in earlier A&A reports, this is a limited-area extent perched water zone.

## Conclusions

- Site closure is recommended;
- Future use will continue to be commercial;
- Best available technology was used, and significant reductions were noted in groundwater; and
- The successful removal of 90% or more of the contamination in the hottest wells (GW1-A and GW4-A) suggests that the remediation activities of March 2008 and April 2009 were successful and groundwater concentrations were reduced in the highest concentration wells.

## Injection of Liquid Immobilizing Agent



## High Pressure: Closely Spaced Delivery



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