



ISCO Treatment Program: VOC Impacted Bedrock

Site

- Truck Maintenance Facility; Central New Jersey.

Contaminants of Concern

- Tetrachloroethylene (PCE)
- Trichloroethylene (TCE)
- Vinyl Chloride (VC)
- 1,1-dichloroethylene (1,1-DCE)
- Carbon Tetrachloride (CT)

Geology/ Hydrology

- Unconsolidated materials underlain by a shale competent bedrock.
- Depth to groundwater is approximately 6 feet bgs.

ISCO Treatment Program

- Modified Fenton's Reagent (MFR) & catalyzed sodium persulfate (CSP)
- Two, 5-6 week injection events.
- Sixty bedrock injection wells targeting multiple depth intervals.

Results

- Average VOC results for all 22 wells sampled show an overall 52% reduction following the last application.
- Project ongoing.

ISOTEC Case Study No. 39

ISCO TREATMENT PROGRAM: VOC IMPACTED BEDROCK

Truck Maintenance Facility
Central New Jersey

INTRODUCTION/ SITE BACKGROUND

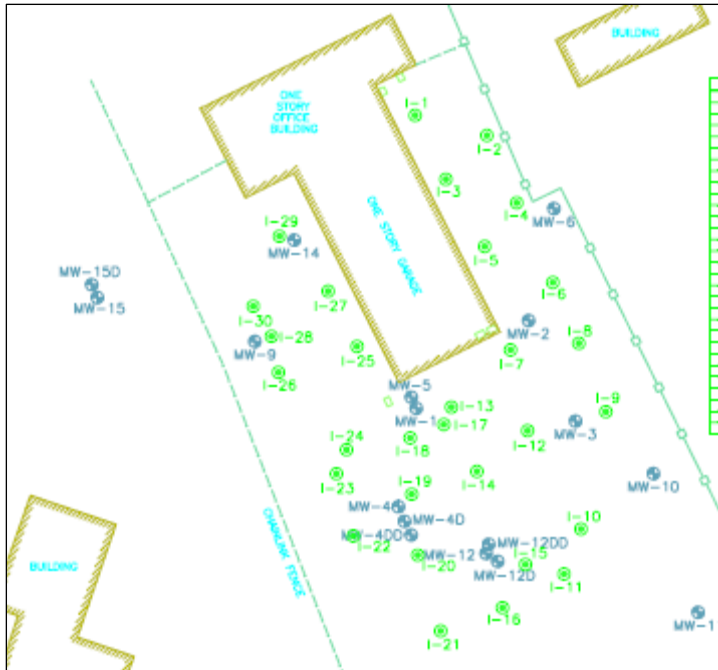
The site is an active Truck Maintenance Facility. Past operations at the site have included storage, maintenance and/or cleaning of trucks since the 1960's. Contaminants of concern at the Truck Maintenance Facility site are volatile organic compounds (VOCs), primarily trichloroethene (TCE), tetrachloroethene (PCE), vinyl chloride (VC), 1,1-dichloroethene (1,1-DCE), chloroform (CF), carbon tetrachloride (CT), benzene and 1,1,1-trichloroethane (1,1,1-TCA). High concentrations of VOCs present at the site indicated the presence of DNAPLs in portions of the site. The VOC plume is centered around the location of a former trench drain. Average concentrations of total VOCs detected in groundwater prior to in-situ chemical oxidation (ISCO) remediation were as high as high as 196,000 micrograms per liter (ug/l) in MW-4, with individual contaminants as high as 100,000 ppb (TCE). Past remedial activities included excavation of contaminated soil down to the top of the weathered bedrock in the suspected source area.

GEOLOGY

Site is underlain by shale of the Passaic formation. Competent bedrock is overlain by up to 10 feet (ft) of unconsolidated materials consisting of in-place weathered bedrock, silt and clay, as well as as some reworked local soil. Groundwater was encountered at approximately 6 ft below ground surface (bgs). General groundwater flow direction is undetermined.

ISCO TREATMENT PROGRAM AND IMPLEMENTATION

The ISCO treatment program was completed as an interim remedial measure (IRM) targeting a portion of the on-site plume where total VOC concentrations in groundwater exceeded 10,000 ug/l. The target treatment area consisted of an approximately 415 ft x 275 ft area (see figure below). The target vertical treatment zone covered the 10 to 100 ft bgs depth interval. Thirty (30) permanently installed injection well (IW) clusters consisting of 30 shallow (screened from 10-50 ft bgs) and 30 intermediate/deep wells (screened from 60-100 ft bgs) were installed at a spacing of 40 ft to deliver the ISCO reagents into the fractured bedrock.



The ISCO treatment program designed for the site consisted of a combination of technologies to be delivered into the fractured bedrock for VOC remediation. The primary ISCO technology utilized at the site consisted of a patented modified Fenton’s reagent (MFR) treatment followed by an activated catalyzed sodium persulfate (CSP) treatment. MFR was injected first to desorb as much contamination from the bedrock and destroy as much DNAPL as possible. Desorption processes caused by the MFR treatment converted the mass to dissolved phase where it was more readily oxidized by both MFR and CSP reagents.

Two ISCO treatment events (Events I and II) targeting the entire 10,000 ug/l plume have been completed thus far with each event lasting between 5-6 weeks to complete. During Event I approximately 8,705 gallons of MFR were injected into the 30 well clusters followed by injection of approximately 9,000 gallons of CSP. Event II focused on the same 30 well clusters with slightly larger injection volumes. Approximately 9,000 gallons of MFR were injected followed by injection of approximately 10,050 gallons of CSP. Typical injection pressures noted at the site ranged from 10-60 pounds per square inch (psi) for most of the IW’s with some requiring slightly higher injection pressures in the 70-90 psi range.

	Event I	Event II
MFR Treatment	8,705 Gallons	9,980 Gallons
Catalyst Volume	2,900 Gallons	3,300 Gallons
H2O2 Volume	5,805 Gallons	6,680 Gallons
CSP Treatment	9,000 Gallons	10,050 Gallons
Catalyst Volume	3,000 Gallons	3,350 Gallons
NA2S2O8 Volume	6,000 Gallons	6,700 Gallons

RESULTS

Treatment Program results indicated an average VOC reduction of 52% in the 22 wells sampled following Event II. Average VOC concentration more than doubled from baseline to post-Event I (consistent with the expected desorption/ DNAPL solubilization trend). Following Event II, however, a sharp reduction was noted in average VOC mass from 34,222 ug/l to 7,839 ug/l (>75% reduction) approximately 6 weeks after Event II. Additional treatment applications are being proposed to further reduce the VOC mass/DNAPL that still exists at the site.

GW VOC Pre vs. Post Treatment Table

Well ID	Baseline VOCs (ug/l)	Post-Event I (6 Weeks) VOCs (ug/l)	Post-Event II (6 Weeks) VOCs (ug/l)	Post-Event II (6 months) VOCs (ug/l)	Overall Reduction (%)
MW-1	18,600	20,000	19,100	20,100	INC
MW-2	12,000	7,850	8,400	4,560	62%
MW-3	3,610	NS	12,500	9,400	INC
MW-4	196,000	229,000	43,400	84,600	57%
MW-5	1,310	2,000	410	203	85%
MW-6	2,220	NS	94	64	97%
MW-7	39	NS	10	11	71%
MW-8	1	NS	ND	0	22%
MW-9	26,200	NS	25,100	241	99%
MW-10	8,810	NS	10,600	12,200	INC
MW-11	810	NS	1,210	881	INC
MW-12	46,700	2,230	25,500	31,600	32%
MW-13	1,740	NS	1,070	1,030	41%
MW-14	28,700	6,810	4,670	4,420	85%
MW-15	21	NS	93	136	INC
MW-4D	41	246	436	80	INC
MW-4DD	2,970	NS	945	679	77%
MW-12D	2,880	NS	2,060	626	78%
MW-12DD	1,670	NS	890	788	53%
MW-13D	9,570	5,640	7,150	4,870	49%
MW-13DD	5,010	NS	794	977	80%
MW-15D	71	NS	181	223	INC
AVERAGE	16,772	34,222	7,839	8,077	52%

Note:

(1) AVERAGE = Average of all 22 wells sampled.