ISCO Soil Mixing Program: Source Area Treatment

Site

- Former Manufacturing Facility (Superfund Site); New Hampshire.

Contaminants of Concern

- 1,1,1 Trichloroethane (TCA)
- 1,1 Dichlorethene (DCE)

Geology/ Hydrology

- Site geology consists of fine sand, underlain by two low permeability layers of clay and silt
- Depth to water was approximately 6-7 feet bgs.
- GW flow is to the southeast.

ISCO Treatment Program

- Modified Fenton Reagent (MFR).
- MFR quantities determined from a bench-scale study.
- ~10,000 sq. ft area from 7-15 ft bgs within the saturated zone (2,963 cubic yards).
- Treatment approach included initial excavation and stockpiling of clean soils, soil mixing of the target area along with concurrent field verification sampling.
- Reagent included 44,710 gallons of MFR (34,360 gallons of ~17-21% stabilized hydrogen peroxide and 10,350 gallons of ISOTEC catalyst).
- Verification monitoring was conducted to ensure adequate mixing was occurring.

Results

- Soil analytical data collected at the site during the course of the soil mixing activities indicated final concentration of COCs below criteria set for the site.
- Long term groundwater monitoring will be performed by the site engineer.

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ISOTEC Case Study No. 78

ISCO Soil Mixing Program: Source Area Treatment Utilizing Modified Fenton's Reagant

Former Manufacturing Facility (Superfund Site)
New Hampshire

INTRODUCTION

ISOTEC, along with our teaming partner Lang Tool Company (LTC), were retained to implement an in-situ chemical oxidation (ISCO) soil mixing treatment program utilizing Modified Fenton's Reagent (MFR) at a Superfund Site in New Hampshire to address volatile organic compound (VOC) source area soils. Designation of the target treatment area was calculated by the site engineer and the reagent dosage was determined from a bench-scale study performed on site samples.

SITE BACKGROUND/GEOLOGY

Past business operations at the site have resulted in groundwater impacts with VOCs, primarily consisting of 1,1,1-trichloroethane (1,1,1-TCA) and 1,1-dichloroethene (1,1-DCE). Target treatment area was relatively flat but required some clearing and grubbing prior to remediation activities. Area of concern (AOC) was an approximately 10,000 square feet (ft^2) area targeting the 7-15 feet below ground surface (bgs) aquifer interval (~2,963 cubic yards). Permitting for the injection activities was governed by the New Hampshire Department of Environmental Services (NHDES) and United States Environmental Protection Agency (USEPA) guidelines.

Site geology consists of thin layers of fine sands, above two low permeability layers, consisting of discontinuous tan clay silt on top of a grey silt layer. Depth to groundwater was approximately 6-7 feet (ft) bgs during field implementation with general flow to the southeast towards an adjacent pond.

ISCO TREATMENT PROGRAM AND IMPLEMEMENTATION

The ISCO soil mixing treatment program was implemented using the MFR process. Target treatment area consisted of an approximately 10,000 ft^2 area targeting the 7-15 ft bgs aquifer interval within the saturated zone. Prior to implementing the soil mixing program, the treatment area was surveyed using GPS equipment to ensure that the entire treatment area was accurately and thoroughly mixed.

Prior to performing mixing activities, land clearing and grubbing activities occurred in order to make the area accessible for

excavation/ soil mixing equipment. Clean (unsaturated overburden) soils from ground surface down to approximately 6-7 ft bgs (current water table depth) were excavated and temporarily stockpiled in order to access the desired vertical treatment interval. The treatment area was divided into approximately 110 (10 ft x 10 ft) treatment cells (some cells were smaller) that were accurately mixed using the on-board GPS system equipped on the LTC Dual Axis Blender (DAB). The GPS system ensured that each designated treatment cell was thoroughly mixed (both aerial and vertical extents) during soil mixing activities. Within each cell, four (4) separate plunges (quadrants) with the DAB were utilized to break-up and homogenize the target soils and introduce pre-determined volumes of MFR reagent into each cell.

To begin the mixing process at each cell, ISOTEC catalyst was initially mixed into the subsurface using the DAB to initially catalyze the area prior to introduction of stabilized hydrogen peroxide. The initial plunges (while introducing catalyst reagent) at each location perform the majority of the mixing/homogenization work required for the soil mixing process. Once the catalyst was introduced and the soils homogenized, introduction of stabilized hydrogen peroxide into each quadrant was performed. After all reagents were introduced into a given cell, the DAB continued to mix and homogenize the entire area ensuring complete contact between COCs and MFR reagents were occurring. A total of 44,710 gallons of MFR reagent (34,360 gallons of 17-21% stabilized hydrogen peroxide and 10,350 gallons of ISOTEC catalyst) were mixed into the target treatment area over a seven day period.

Performance monitoring sampling was conducted by ISOTEC/ LTC personnel during mixing activities to ensure that adequate mixing was occurring across the entire vertical column. Samples were collected the day following mixing at a given cell, utilizing a specially designed telescoping forklift mounted sampling tool capable of collecting samples at discrete depths (typically 9, 11 and 13 ft bgs). Samples were analyzed for iron and hydrogen peroxide (using field kits), VOCs (sub sample sent to an analytical lab) and visual observations to ensure adequate mixing was occurring. A total of 56 samples were collected over the duration of the treatment program.

Laboratory samples were analyzed for soil VOCs with goal of attaining the following criteria for 1,1,1-TCA (≤ 150 µg/kg) and 1,1-DCE (≤ 60 µg/kg). Of the samples collected during initial attempt, 53 of 56 locations indicated concentrations of target COCs at or below the criteria specified for the site. For the 3 locations that indicated initial concentrations above criteria, re-mixing of additional MFR reagents was implemented at those locations (along with re-mixing of some adjacent cells based on current COC concentrations) with subsequent re-sampling occurring upon completion. The 3 locations all indicated COC concentrations below criteria following the re-mixing applications. Upon verification from the site engineer that the requirements for the soil mixing program were completed, the site was backfilled and restored (by others).

CURRENT PROJECT STATUS

The objective of the ISCO treatment program was to thoroughly blend MFR into the target treatment area in an effort to reduce VOC, specifically 1,1,1 TCA and 1,1-DCE concentrations below post treatment criteria set for the site. Based on the soil analytical data collected at the site during the course of the soil mixing activities, which indicated final concentration of the site COCs below criteria; it is estimated that a substantial portion of the residual mass that existed at the site was removed during the ISCO soil mixing treatment program. Long term groundwater monitoring will be completed by the engineer under the direction of NHDES/USEPA.

Site Figure Showing Treatment Area and Cell Designation