

## Project Summary

# Combined Surfactant and ISCO Pilot Program of Petroleum Hydrocarbon Impacted Groundwater



Case Study 118

Location: DOD Facility, New Mexico

History: Former USTs

Contaminants: Petroleum Hydrocarbons and NAPL

Treatment Area: 600 sq ft

Treatment Interval: 0 to 70 ft bgs

Lithology: Sandy Silt & Weathered Bedrock

Remedy Approach:

- Surfactant Enhanced Fluid Recovery (SERF)
- ISCO Treatment via Modified Fenton's Reagent

Remediation Results:

- Free Product has not been observed in over a year

### INTRODUCTION

ISOTEC was retained to implement a combined remediation technology pilot test with surfactant enhanced fluid recovery (SERF) and in-situ chemical oxidation (ISCO) to treat residual petroleum hydrocarbon contamination, including free product. The target treatment interval was approximately 70-75 ft bgs.

### SITE BACKGROUND

A gasoline release associated with former underground storage tanks resulted in groundwater sand soil impacted with petroleum hydrocarbons including benzene, toluene, ethylbenzene, and xylenes (BTEX), gasoline-range organics (GRO), and total polynuclear aromatic hydrocarbons (PAHs). Recovery wells, soil vapor extraction, and bioventing were performed at the site; however, non-aqueous phase liquid (NAPL) thickness remained in monitoring wells, ranging from 0.1 and 1.1 feet. The treatment area for the project was approximately 600 square feet, directly beneath a former fueling area. Subsurface lithology is characterized as a granite 'bowl' shaped feature overlain by fractured bedrock and silty sand, sedimentary deposits. Depth to groundwater is approximately 65 feet bgs.

### SEFR & ISCO TREATMENT PROGRAM

The objective of the pilot test was to demonstrate the effectiveness of the combined surfactant enhanced fluid recovery (SEFR) and in-situ chemical oxidation (ISCO) processes for reducing the hydrocarbon contaminant mass sufficiently to attain and maintain target cleanup levels for contaminants in groundwater and residual NAPL.

E-Mulse 10 surfactant was utilized to solubilize the NAPL to break up free product and improve removal. Existing recovery wells (screened from ~70 ft bgs to surface) were utilized deliver the surfactant which allowed for smear zone flushing to address residual NAPL. The first pilot test event consisted of E-Mulse 10 surfactant injections into 5 recovery wells within the 600 sq-ft area that contained the NAPL. Over a 3-day injection event, 2,045 gallons of E-Mulse 10 Surfactant at a 4% concentration and 2,760 gallons of flush water was injected. An interfacial tension meter (IFT) was used by ISOTEC in the field to document breakthrough of surfactant solution in nearby wells. Following the surfactant injection event, groundwater extraction was conducted from the 5 recovery wells weekly for approximately 5 months removing ~3,600 gallons and 4 pounds of TPH -GRO.

Following the extraction phase, ISOTEC completed an application of MFR to further the reduce dissolved petroleum mass. ISCO injections were performed into the site recovery wells. A total of 1,189 gallons of diluted hydrogen peroxide (2-5% by weight) and 950 gallons of ISOTEC's chelated iron catalyst were injected in the five recovery wells over 3 days.

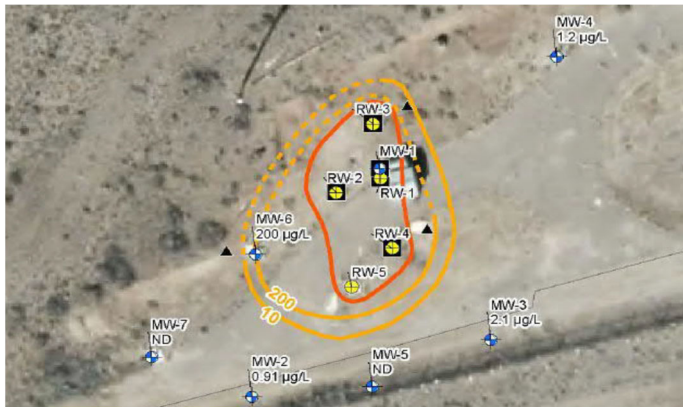
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ISOTEC completed an additional three injection events using E-Mulse 10 surfactant over a one year period (approximately 12, 18, and 23 months after the initial surfactant injection). Approximately 1,900 gallons of surfactant and 1,900 gallons of flush water were injected during each of the three additional surfactant events.



**FIGURE 1**

E-Mulse-10 surfactant was injected into existing recovery wells over four events. ISOTEC monitored for surfactant “breakthrough” during injections utilizing an Interfacial Tension (IFT) meter. This meter measures the interfacial tension of two immiscible fluids, which provided real time presence of surfactant-NAPL mixture/emulsion in adjacent monitoring wells.



**FIGURE 2**

Approximate locations of recovery wells and monitoring wells.

### CURRENT PROJECT STATUS

Following the initial surfactant injection and subsequent fluid extraction, NAPL has not been detected in 4 of the 6 wells where measurable NAPL was recorded prior to ISOTEC’s pilot study. The remaining two wells have periodic NAPL observation of less than 1 inch, compared to more than 1 foot prior to SEFR activities. Groundwater concentration of total BTEX was reduced by 80%. The client will be collecting long-term post-treatment samples to monitor the continued effectiveness of the combined SEFR and ISCO remediation.

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