



***SEPR (Surfactant Enhanced Product Recovery) Pilot Test for
Remediation of Creosote at a Louisiana, U.S. Superfund Site***



Summary

A pilot test was implemented to demonstrate the efficacy of Surfactant Enhanced Product Recovery (SEPR)¹ for enhancing the removal of creosote DNAPL and improving yield from the existing recovery system. Implementation took place over 2.5 months, during which approximately 31,600 gallons of SEPR chemicals were injected.

Results from the pilot test demonstrated SEPR was effective for enhancing creosote DNAPL removal. Recovery rates were improved by over 100% from existing saturated zone wells and TPH mass was reduced by 84% in the vadose zone treatment area.

Site Background

This 34-acre site was a former wood treating facility that used creosote and pentachlorophenol (PCP) to treat various wood products between 1901 and 1981. It is estimated that the site consisted of approximately 25,000 cubic yards of TAR mat deposits, 275,000 cubic yards contaminated soils, 1 million gallons subsurface creosote product, and 24 million gallons contaminated groundwater.

The facility was placed on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) in 1992 and has undergone an extensive remediation effort, including installation of a recovery system.

PROJECT PROFILE

Site

Former Wood Treatment Facility
Louisiana

Contaminants of Concern

Creosote DNAPL

Objectives

Demonstrate the efficacy of SEPR
for enhanced NAPL recovery

Enhance well yield of the existing
recovery system

Treatment Approach

Surfactant Enhanced Product
Recovery (SEPR)

Results

Enhanced recovery rates of
existing wells by more than 100%

Achieved 84% TPH mass reduction
in the vadose zone treatment area

Enhanced the removal of creosote
NAPL from the vadose and
saturated zone

¹ Ethical Solutions, LLC acquired the intellectual property developed by VeruTEK Technologies, in September 2014. Contact us at 860-757-3788 | 177 Governor's Hwy, South Windsor, CT 06074 | Visit us at www.ethicalchem.com

The recovery system, which has been operational for approximately 16 years, is comprised of twenty-eight recovery wells and trench sumps, several injection wells and injection trenches, an onsite process liquid treatment system (PLTS), and an extensive array of underground piping to convey fluids to and from the PLTS. The baseline creosote NAPL recovered from the existing recovery system, before implementing the pilot test, is estimated to have averaged 5 gallons per day.

Implementation

The pilot test was designed to determine the extent of contaminant removal that could be achieved using SEPR, a low cost treatment approach, across the combined vadose and saturated zones. Most of the contamination in the pilot test area existed as concentrated NAPL at depths between 10.5 ft and 24.5 ft bgs.

The pilot test began with rehabilitation of existing recovery wells. The well cleaning was intended to remove NAPL clogging in the well screens and clear immediate near field around the wells. During this phase SEPR chemicals were injected and extracted in small volumes (<50 gallons per well).

Approximately 8,600 gallons of SEPR chemicals (consisting of VeruSOL Creosote Formula and hydrogen peroxide) were injected into the vadose zone treatment area to address the NAPL contamination present in the targeted depth interval of 9-19 ft bgs. The saturated zone treatment included a depth interval ranging from 16-29 ft bgs and received approximately 23,000 gallons of SEPR chemicals.

Technology Background

EthicalChem's SEPR technology is a patented process that uses simultaneous application of surfactants and low concentrations of hydrogen peroxide to enhance the removal of NAPL.

The surfactants used in the SEPR process lower the interfacial tension and decrease the capillary forces keeping the NAPL in place, resulting in greater mobility of the NAPL phase. Additionally, the simultaneously injected hydrogen peroxide helps loosen the NAPL enabling it to be buoyant and thus facilitate the NAPL transport towards recovery wells

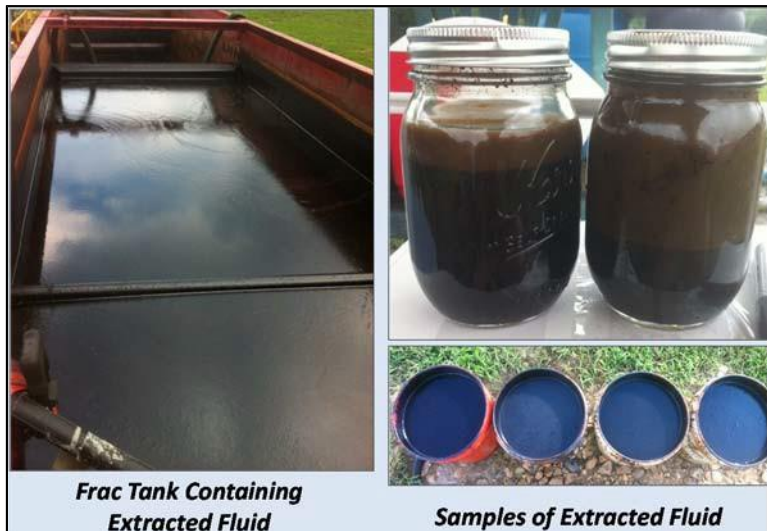
Results

NAPL Recovery

Approximately 8100 gallons of fluid containing NAPL and emulsion were recovered from the vadose zone; and about 24,000 gallons of fluid with NAPL and emulsion were recovered from the saturated zone treatment area. The image to the right shows extracted fluid at the site.

Total Petroleum Hydrocarbons

The results of post injection sampling show that during SEPR the bulk of the TPH fraction of creosote NAPL was extracted from the vadose zone treatment area. **Table 1** shows comparison of the overall pre- and post-treatment TPH masses at each well location.



¹ Ethical Solutions, LLC acquired the intellectual property developed by VeruTEK Technologies, in September 2014. Contact us at 860-757-3788 | 177 Governor's Hwy, South Windsor, CT 06074 | Visit us at www.ethicalchem.com

Table 1: Vadose Zone Pilot Test Area Pre and Post Treatment TPH Mass					
Well Location	Pretreatment Sample Depth Interval	Post treatment Sample Depth Interval	Pretreatment TPH Mass (kg)	Post treatment TPH Mass (kg)	% Reduction
I11	10-17.7 ft	10-17 ft	396	15	96%
I12	10-18.6 ft	10-21.3 ft	526	34	94%
I13	10-19.7 ft	10-20 ft	455	65	86%
I14	10-16.4 ft	10-20 ft	185	67	64%
I15	10-19 ft	10-19 ft	161	98	39%
Total			1724	280	84%

This table indicates that the most heavily contaminated locations I11, I12 and I13 achieved significant TPH mass removal rates of 96%, 94% and 86% respectively. Overall, the TPH mass in the vadose zone was reduced by 84%, from 1,724 kg to 280 kg.

Recovery Well Performance

Pre and Post SEPR NAPL recovery rates were measured at existing recovery well locations R5, R9, R10, R12, R15, R17, and R18 to assess the effectiveness of SEPR treatment in improving the performance of the existing recovery wells. A comparison of the well yield test results is summarized in **Table 2**.

Table 2 : Pre and Post SEPR Average Yield			
Well	Pre SEPR Average Yield (gpm)	Post SEPR Average Yield (gpm)	% Increase
R5	0.82	2.40	193%
R9	0.16	1.11	594%
R10	0.11	0.23	109%
R12	0.24	1.27	429%
R15	0.31	0.67	116%
R17	0.04	0.54	1250%
R18	0.15	0.45	200%

The baseline groundwater pumping rates averaged between 0.04 to 0.8 gallons per minute as shown in the table above. All wells achieved significant increases of greater than 100% in yields post SEPR treatment.

Conclusions

The pilot test demonstrated that EthicalChem patented SEPR technology was able to enhance the removal of free phase creosote NAPL from the vadose and saturated zones. SEPR substantially improved the liquid extraction performance of the existing recovery wells in the saturated zone, with increases of 100% to over 1,200%. The treatment met the pilot test objectives for bulk contaminant removal and also achieved an 84% reduction of TPH in the vadose zone.

¹ Ethical Solutions, LLC acquired the intellectual property developed by VeruTEK Technologies, in September 2014. Contact us at 860-757-3788 | 177 Governor's Hwy, South Windsor, CT 06074 | Visit us at www.ethicalchem.com