



Petrox[®] Bioremediation by Petrox[®]

Surface Spills to Deep Subsurface Success

Petrox[®] bioremediation is used to remediate petroleum contamination in soil and ground water under many different conditions. From surface spills to deep soil and ground water contamination, Petrox has successfully removed the contamination and environmental risk. While every site is unique, the following case studies provide a basis for confidently selecting Petrox bioremediation for your project.

Surface Spills

Spills onto the ground surface can penetrate paving and soil making removal difficult. Petrox can be applied to the surface at the spill to degrade the petroleum without excavation or disruption of property use.

Texas Industrial Site

Storm water discharges into retention ponds and drainage ditches from industrial properties can carry a mix of industrial oils and fuels. At a site in Texas the accumulation of petroleum in a drainage ditch required quick and cost effective remediation. Petrox was sprayed on the ground surface in the sloped sides of the drainage ditch 30 and 60 feet from the discharge pipe. The following table show the sampling results 30 days after applying Petrox.

Location		C12-C28 (mg/kg)	C28-C35 (mg/kg)	Total TPH (mg/kg)
30' N	Before	510	520	1,030
	After	250	290	540
	After 2nd treatment	64	79	143
60' N	Before	1,100	920	2,020
	After	71	89	160
30' S	Before	350	240	490
	After	33	41	74
60' S	Before	920	830	1,750
	After	<14	20	20

Surface Seepage

Spills may penetrate the ground surface at the source of the spill, but daylight as a seepage from the ground at a drainage ditch or hillside. Petrox may be applied at the surface source area, in the subsurface, or at the seepage point to eliminate the seepage problem.

Trinidad Oil Storage Site

Petroleum had entered the subsurface under a large above ground storage tank in a remote area of Trinidad. The petroleum seeped from a hillside downslope from the tank. A trench was dug to capture the seepage water, and Petrox was applied to the oily water in the trench to remove the petroleum. The following results show how quickly the Petrox removed the petroleum.

Seepage Sampling Results		
	Oil and Grease (mg/L)	Total Petroleum Hydrocarbons (mg/L)
Pre-Treatment	10,987	3,132
6 Days After Treatment	2,904	1,319
12 Days After Treatment	<1.6	<1.4

Railroad Spill, Ohio

After a petroleum spill on an active railroad line, the affected ballast and soil were removed. After the rail was restore to operation, oil was observed seeping out of the downslope embankment. Sumps installed at the base of the steep slope showed the presence of LNAPL on the perched ground water. Petrox was injected in the original soil excavation to treat the oil in the source and subsurface under the source. In less than 90 days after treatment the LNAPL was degraded in place so that LNAPL was no longer seeping from the hillside.

Sump Number	LNAPL Thickness (ft.)			
	Pre-Treatment	30 Days Post Treatment	60 Days Post Treatment	90 Days Post Treatment
1	0.04	0.06	No LNAPL	No LNAPL
10	0.15	0.12	0.08	No LNAPL
11	0.13	0.08	0.07	No LNAPL
15	0.12	0.10	0.18	No LNAPL

Soil Contamination

Petroleum in soil is often the result of spills, on-going leaks, or may accumulate from long periods of industrial operations or the historical use of industrial by products as fill. If the contaminated soil causes vapor or ground water contamination, Petrox bioremediation can remove the “tea bag” that is the source of vapor or ground water risks.

East Chicago Industrial Site

Petrox was used to remove contamination from ground water at an industrial site where industrial fill was the source of petroleum in ground water. Petrox was applied to the impaired soil above the water table. The following table shows the wide range of petroleum hydrocarbons that Petrox microbes can metabolize to protect the ground water quality.

Contaminant	Pre-Treatment (mg/L)	Post-Treatment (mg/L)	
	4/6/15	7/26/15	8/10/15
DRO	8.9	4.6	4.1
ERO	9.7	5.3	4.4
Aceaphenthene	0.0081	0.0052	0.0043
Anthracene	0.0011	0.00082	0.0007
Naphthalene	0.0024	0.0020	0.0013
Pheneanthrene	0.0052	0.0018	0.0032
Pyrene	0.0013	0.0011	0.00078

Pipeline Leak, West Texas

Petrox was applied to contaminated soil around a petroleum pipeline deep below the ground surface to remove the source of petroleum seeping out of a river bank. A monitoring well was used to track the progress of the subsurface remediation. After Petrox treatment the seepage stopped and the petroleum concentrations in ground water concentrations were reduced significantly. The following table summarizes the ground water monitoring results.

	Hydrocarbon Concentrations (mg/L)	
	C ₁₂₋₂₈	C ₂₈₋₃₅
Pre-bioremediation	460	120
Post-bioremediation	19	8.4

Underground Storage Tank Leaks

Combined Soil Flushing and Dissolved Phase Treatment Real Gas Station, Ohio

A combination of Petrox EC and Petrox were used to remove petroleum absorbed onto soil above the water table and dissolved phase in the ground water at a retail gas station. Petrox EC is a combination of Petrox microbes and a surfactant that can flush the petroleum from soil and leave behind a population of petroleum-metabolizing microbes to continue treatment. Petrox EC was applied to petroleum-impacted granular bedding around piping and USTs. Petrox was

applied to the ground water to remove dissolved phase petroleum from the original release and flushed from the vadose zone. The following table shows the results of one treatment with Petrox and Petrox EC.

Contaminant	Source Area (mg/L)		Down Gradient Results (mg/L)	
	Before	After	Before	After
Benzene	5.02	0.033	3.59	<0.05
Toluene	22.0	0.014	19.6	0.169
Ethylbenzene	2.88	0.174	3.15	0.167
Xylene	14.8	0.056	17.7	0.883

California UST Remediation

Petrox bioremediation was implemented to treat residual contamination in ground water in conjunction with soil excavation following the removal of a gasoline UST. Petrox was also used to treat the excavated soil by land farming on-site. Ten 55-gallon drums of hydrated Petrox microbes were injected into the ground water. In addition to Petrox, 100 pounds of an oxygen supplement was added to support the aerobic metabolism. The injection was by direct push methods at 11 locations within the 7,000 square foot ground water plume.

	Sampling Date	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Xylene (µg/L)
Pre-Injection	5/29/08	8,500	240	53	670	63
Post-Injection	11/24/08	650	1.7	4.5	5.9	1.9
	2/24/09	57	<0.50	<0.50	<1.0	<0.50
	8/27/09	<50	<0.50	3.2	<1.0	<0.50

Ground Water Plume Remediation

South Carolina Industrial Site

Petrox was injected in a petroleum ground water plume to remove petroleum contamination at an industrial site. With one application, the petroleum constituents were below detection limits in under six months.

	Sampling Date	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylene (ug/L)	Naphthalene (ug/L)
Pre-Injection	1/8/14	210	1,100	180	3,500	530
30 Days After	4/25/14	58	300	28	1,100	65
6 Months After	9/3/14	<0.2	<1.7	<1.7	<1.7	<1.7

Conclusions

Every site presents unique challenges, but the use of Petrox® microbes removes much of the uncertainty regarding remedial performance. CL Solutions provides site evaluations and background biological testing to determine whether a site is appropriate for Petrox® bioremediation. Contact CL Solutions to discuss your site at msaul@cl-solutions.com or 513-475-6625.