CASE STUDY

Evaluation of Bioxy Soil Restorer For Hydrocarbon Remediation

A Case Study Conducted by Bioxy's Technology Partner 3Tier Technologies In Cooperation with OES Industries, Somerset Energy Refining, and Greenhills Environmental

Objective
To evaluate the performance of Bioxy SoilRestorer (A specially formulated blend of activated organic biopolymer (AOB), an ultra-high concentration of live synergistic bacteria, and a readily biodegradable natural enzyme) on the remediation of various hydrocarbon soil contaminations.

Location
Somerset Refining
Somerset, Kentucky

Hydrocarbon Type
Crude Oil 2 and Gasoline

Plot Design
The trial consisted of two framed 4'X4' treatment areas within a crude oil spill area and a gasoline spill area.

Application Method
The product was mixed at a 20 to 1 ratio with water (32 ounces of SoilRestorer with 5 gallons of water) in a five gallon bucket. Each plot received 2.5 gallons of diluted product using a watering can. This drench method was used to mimic application by a water truck and/or large volume area application.

Treatments
Each plot received the same treatment diluted as presented above.

Day 1: 2.5 gallons of pre-diluted SoilRestorer as specified above
Day 5: 2.5 gallons of pre-diluted SoilRestorer as specified above

Data Collection

Each location had a composite soil sample taken prior to the initial treatment, a second sample taken on Day 5 prior to the second treatment and again on day 14. The gasoline treatment area was tested using Method 8021B and the crude oil treatment area was tested using Method 8021B & 8270C. All testing was completed by Environmental Science Corporation in Mt. Juliet Tennessee.

Testing Results:

Crude Oil – Collection Date 8/31/09

Parameter	Result	Det. Limit	Method	Date Tested
Benzene	15.	0.25	8021B	09/08/09
Toluene	54.	2.5	8021B	09/08/09
Ethylbenzene	33.	0.25	8021B	09/08/09
Total Xylene	190.	0.75	8021B	09/08/09
Surrogate Recovery (%)				
a,a,a-Trifluorotoluena (PID)	96.1		8021B	09/08/09
Polynuclear Aromatic Hydrocarbon				
Extraction Date	09/03/09		8270C	09/08/09
Carcinogenic PAH				
Benzo (a) anthracene	BDL	6.6	8270C	09/08/09
Benzo (a) pyrene	BDL	6.6	8270C	09/08/09
Benzo (b) flouranthene	BDL	6.6	8270C	09/08/09
Benzo (k) flouranthene	BDL	6.6	8270C	09/08/09
Dibenz (a,h) anthracene	BDL	6.6	8270C	09/08/09
Indeno (1,2,3 –cd) pyrene	BDL	6.6	8270C	09/08/09
NonCarcinogenic PAH				
Acenaphthene	BDL	6.6	8270C	09/08/09
Acenaphthylene	BDL	6.6	8270C	09/08/09
Anthracene	BDL	6.6	8270C	09/08/09
Benzo (g,h,i) perylene	BDL	6.6	8270C	09/08/09
Flouranthene	BDL	6.6	8270C	09/08/09
Flourens	BDL	6.6	8270C	09/08/09
Phenanthrene	15.	6.6	8270C	09/08/09
Pyrene	BDL	6.6	8270C	09/08/09
Other PAH				
Chrysene	BDL	6.6	8270C	09/08/09
Naphthalene	27.	6.6	8270C	09/08/09

Crude Oil – Collection Date 9/23/09

Parameter	Result	Det. Limit	Method	Date Tested
Benzene	0.15	0.25	8021B	10/03/09
Toluene	2.5	2.5	8021B	10/02/09
Ethylbenzene	3.8	0.25	8021B	10/02/09
Total Xylene	68.	0.75	8021B	10/02/09
Surrogate Recovery (%)				
a,a,a-Trifluorotoluena (PID)	101.		8021B	10/03/09
Polynuclear Aromatic Hydrocarbon				
Extraction Date	10/01/09		8270C	10/03/09
Carcinogenic PAH				
Benzo (a) anthracene	BDL	6.6	8270C	10/03/09
Benzo (a) pyrene	BDL	6.6	8270C	10/03/09
Benzo (b) flouranthene	BDL	6.6	8270C	10/03/09
Benzo (k) flouranthene	BDL	6.6	8270C	10/03/09
Dibenz (a,h) anthracene	BDL	6.6	8270C	10/03/09
Indeno (1,2,3 –cd) pyrene	BDL	6.6	8270C	10/03/09
NonCarcinogenic PAH				
Acenaphthene	BDL	6.6	8270C	10/03/09
Acenaphthylene	BDL	6.6	8270C	10/03/09
Anthracene	BDL	6.6	8270C	10/03/09
Benzo (g,h,i) perylene	BDL	6.6	8270C	10/03/09
Flouranthene	BDL	6.6	8270C	10/03/09
Flourens	BDL	6.6	8270C	10/03/09
Phenanthrene	1.0	6.6	8270C	10/03/09
Pyrene	BDL	6.6	8270C	10/03/09
Other PAH				
Chrysene	BDL	6.6	8270C	10/03/09
Naphthalene	1.3	6.6	8270C	10/03/09

Crude Oil – Collection Date 10/02/09

Parameter	Result	Det. Limit	Method	Date Tested
Benzene	0.13	0.10	8021B	10/12/09
Toluene	1.8	1.0	8021B	10/12/09
Ethylbenzene	4.4	0.10	8021B	10/12/09
Total Xylene	45.	0.30	8021B	10/12/09
Surrogate Recovery (%)				
a,a,a-Trifluorotoluena (PID)	97.9		8021B	10/12/09
Polynuclear Aromatic Hydrocarbon				
Extraction Date	10/07/09		8270C	10/11/09
Carcinogenic PAH				
Benzo (a) anthracene	BDL	1.6	8270C	10/11/09
Benzo (a) pyrene	BDL	1.6	8270C	10/11/09
Benzo (b) flouranthene	BDL	1.6	8270C	10/11/09
Benzo (k) flouranthene	BDL	1.6	8270C	10/11/09
Dibenz (a,h) anthracene	BDL	1.6	8270C	10/11/09
Indeno (1,2,3 –cd) pyrene	BDL	1.6	8270C	10/11/09
NonCarcinogenic PAH				
Acenaphthene	BDL	1.6	8270C	10/11/09
Acenaphthylene	BDL	1.6	8270C	10/11/09
Anthracene	BDL	1.6	8270C	10/11/09
Benzo (g,h,i) perylene	BDL	1.6	8270C	10/11/09
Flouranthene	BDL	1.6	8270C	10/11/09
Flourens	BDL	1.6	8270C	10/11/09
Phenanthrene	2.7	1.6	8270C	10/11/09
Pyrene	BDL	1.6	8270C	10/11/09
Other PAH				
Chrysene	BDL	1.6	8270C	10/11/09
Naphthalene	4.5	1.6	8270C	10/11/09

Gasoline – Collection Date 8/31/09

Parameter	Result	Det. Limit	Method	Date Tested
Benzene	140	2.5	8021B	09/08/09
Toluene	2000	50.	8021B	09/08/09
Ethylbenzene	810	2.5	8021B	09/08/09
Total Xylene	5500	15.	8021B	09/08/09
Surrogate Recovery (%)				
a,a,a-Trifluorotoluena (PID)	97.9		8021B	09/08/09

Gasoline – Collection Date 9/23/09

Parameter	Result	Det. Limit	Method	Date Tested
Benzene	BDL	0.025	8021B	09/30/09
Toluene	BDL	0.25	8021B	09/30/09
Ethylbenzene	0.52	0.025	8021B	09/30/09
Total Xylene	7.6	0.075	8021B	09/30/09
Surrogate Recovery (%)				
a,a,a-Trifluorotoluena (PID)	99.1		8021B	09/30/09

Gasoline – Collection Date 10/02/09

Parameter	Result	Det. Limit	Method	Date Tested
Benzene	BDL	0.025	8021B	10/12/09
Toluene	BDL	0.25	8021B	10/12/09
Ethylbenzene	0.64	0.025	8021B	10/12/09
Total Xylene	8.4	0.075	8021B	10/12/09
Surrogate Recovery (%)				
a,a,a-Trifluorotoluena (PID)	97.7		8021B	10/12/09

Summary

In the Crude Oil Site, Benzene was reduced from 15 mg/kg to 0.13 mg/kg, Toluene was reduced from 54 mg/kg to 1.8 mg/kg, Ethylbenzene was reduced from 33 mg/kg to 4.4 mg/kg, and Total Xylene was reduced from 190 mg/kg to 45 mg/kg. Though all levels did not exceed the EPA Minimum Standard, all contaminant levels were reduced to below the EPA Minimum Soil Contamination level after only five days. This remediation process has converted the hydrocarbon contaminates into biologically produced enzymes, CO2, and H2O.

In the Gasoline Site, Benzene was reduced from 140 mg/kg to BDL (Below Detectable Levels), Toluene was reduced from 2000 mg/kg to BDL, Ethylbenzene was reduced from 810 mg/kg to 0.64mg/kg, and Total Xylene was reduced from 5500 mg/kg to 8.4 mg/kg. On this site the levels of contamination ranged from 4 times above the Minimum Standard to as high as 12 times the standard. Within the first five days, all levels were below the standard and all contaminates have been converted into harmless biologically produced enzymes, CO2, and H2O.

Other key factors identified during the trial period that positively influenced the performance of the product include:

- Stable air & soil temperatures. As the air & soil temperatures are reduced, performance of the product will slow.

- Beneficial rainfall. During the first 14 days of treatment, the site received light rainfall either daily or every other day. Moisture is a critical component to biological activity and is why it is important to know that during severe summer months, treatment areas may need to be moistened periodically to achieve maximum results.
- Drench application. As mentioned above, moisture is a critical tool in the success of the application. Drenching the area with a high volume of solution enables the product to penetrate the same cracks and crevices in the soil that the contaminant will penetrate.
- Type of contaminate and level of contamination. Through this real world trial and through our lab tests, the higher the processing done to the hydrocarbon, the easier it is to neutralize and remediate the area. Heavier, unprocessed crude may require additional treatments to achieve the same results as on fuel grade hydrocarbons. Conditions as previously mentioned will be more important for maximum performance for less processed hydrocarbon contamination.

In conclusion, this trial validated that a natural, environmentally safe, non-toxic, non-polluting product can outperform conventional practices.

For more information, please visit our website at www.bioxyresearch.com or contact us at info@bioxyresearch.com or 855-55-BIOXY.