Evaluation of Soil Rx for Hydrocarbon Remediation Using Landfarming

Case Study - Final Report

Study Completed in cooperation with:
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Introduction

Bioremediation is a type of biotechnology in which living organisms or ecological processes are utilized to deal with some environmental contamination problem. The most common use of bioremediation is to metabolically break down or otherwise remove toxic chemicals before or after they have been discharged into the environment. In such uses, bioremediation takes advantage of the fact that certain microorganisms can utilize contaminates as metabolic substrates (food source), in the process rendering them into simpler, less toxic compounds, and in most cases eliminating them. Bioremediation is a relatively new and actively developing technology.

In general, bioremediation methodologies focus on: (1) enhancing the abundance of certain species or groups of microorganisms that can metabolize toxic chemicals (this is also known as bioaugmentation) and/or (2) optimizing environmental conditions for the actions of these organisms (also known as biostimulation). Bioaugmentation may involve the deliberate addition of strains or species of microorganisms that are specifically effective at treating particular toxic chemicals, but are not indigenous to or abundant in the treatment area. Biostimulation usually involves fertilization, aeration, or irrigation in order to decrease the importance of environmental factors in limiting the activity of microorganisms. Biostimulation focuses on rapidly increasing the abundance of naturally occurring, ubiquitous microorganisms capable of dealing with certain types of environmental problems.

3 Tier Technologies has discovered that current products offered in today's markets offer a single solution that only impacts either bioaugmentation or biostimulation. The development of a complete regeneration solution would not only enhance the remediation of contaminates, it would also regenerate the soil to a healthy and active state for effective and safe re-use. 3 Tier utilizes a special recipe of three distinct yet synergistic components, a blend of activated humic acid, a ultra high concentration of live synergistic bacteria, and a readily biodegradable natural enzyme product consisting of a nutrient-rich extract with a broad-spectrum package of identifiable enzymes, coenzymes, amino acids and other proteins. This triple action product is able to degrade hydrocarbons with minimal use of equipment, labor and cost.

Methods & Materials

Method - Landfarming/Biopiles: Landfarming/Biopile treatment is a full-scale technology in which excavated soils are mixed with soil amendments and placed on a treatment area that includes leachate collection systems and some form of aeration. It is used to reduce concentrations of petroleum constituents in excavated soils through the use of biodegradation. Moisture, heat, nutrients, oxygen, and pH can be controlled to enhance biodegradation.

The treatment area will generally be covered or contained with an impermeable liner to minimize the risk of contaminants leaching into uncontaminated soil. The drainage itself may be treated in a bioreactor before recycling. Vendors have developed proprietary nutrient and additive formulations and methods for incorporating the formulation into the soil to stimulate biodegradation. The formulations are usually modified for site-specific conditions.

Soil piles and cells commonly have an air distribution system buried under the soil to pass air through the soil either by vacuum or by positive pressure. The soil piles in this case can be up to 20 feet high (generally not recommended, 2-3 meters maximum). Soil piles may be covered with plastic to control runoff, evaporation, and volatilization and to promote solar heating. If there are VOCs in the soil that will volatilize into the air stream, the air leaving the soil may be treated to remove or destroy the VOCs before they are discharged to the atmosphere.

Materials: The trial started by creating one 50 cubic meter pile of contaminated material. Prior to creating the two 25 cubic meter test piles, all material was run through a material screener to remove any rocks, clumps, or foreign organic material. A uniform composite sample was pulled from the host pile to establish the initial contamination level of the material. The following is the initial composite sample levels.
Note: All soil testing is in compliance with Ontario Regulation 153 – Petroleum Hydrocarbons F1-F4 (C6-C50) in soil.

PARAMETER	UNIT	RDL	LEVEL
Benzene	ug/g	0.02	0.13
Toluene	ug/g	0.08	32
Ethylbenzene	ug/g	0.05	11
Xylene Mixture (Total)	ug/g	0.05	100
C6 – C10 (F1)	ug/g	5	440
C6 – C10 (F1 minus BTEX)	ug/g	5	300
C>10 – C16 (F2)	ug/g	10	5900
C>16 – C34 (F3)	ug/g	10	4700
C>34 – C50 (F4)	ug/g	50	<50
Gravimetric Heavy Hydrocarbons	ug/g	50	N/A
Moisture Content	%	0.01	11.3

Two equal 25 cubic meter piles were created from the composite material. Each pile was measured and treated with the appropriate products via a conveyor system that is equipped with a calibrated spray system that evenly distributes liquid treatment material per manufacturer specifications.

One pile was treated with a regionally available microbial product called Nitro. This material is applied at a rate of 18 liters of diluted product per cubic meter of soil. The second pile was treated with Soil Rx (See Attached) that was diluted at a rate one part Soil Rx concentrate to 10 parts clean water. The second pile was treated with 5 liters of diluted Soil Rx per cubic meter of material.

Both piles were constructed as previously described with appropriate air ventilation systems and no additional moisture, nutrients, or other additives. Each pile was monitored using a RKI Petro Hydro Carbon meter and Petro Flag Measure instrument. Periodic measurements included CO2, O2, moisture, and Petro Hydrocarbon's.

Results & Discussion

On July 9 2010, both treatment piles were completed as previously discussed and the trial was commenced. Over the course of the next two weeks, normal monitoring was conducted to determine when the piles had achieved a level of remediation to meet Ontario Regulation 153 standards. On July 23 2010, onsite monitoring reflected that the Soil Rx pile had achieved regulatory levels that meet or exceed Reg. 153. A composite sample from each pile was collected and sent off for formal laboratory confirmation. The following are the July 23 2010 results:

Parameter	Unit	RDL	July 9 Level	July 23 Nitro	July 23 Soil Rx	Soil Rx Change
Benzene	ug/g	0.02	0.13	N/A	N/A	-100.00%
Toluene	ug/g	0.08	32	N/A	N/A	-100.00%
Ethylbenzene	ug/g	0.05	11	N/A	N/A	-100.00%
Xylene Mixture (Total)	ug/g	0.05	100	N/A	N/A	-100.00%
C6 – C10 (F1)	ug/g	5	440	N/A	N/A	-100.00%
C6 – C10 (F1 minus BTEX)	ug/g	5	300	N/A	N/A	-100.00%
C>10 – C16 (F2)	ug/g	10	5900	90	19	-99.67%
C>16 – C34 (F3)	ug/g	10	4700	350	130	-97.23%
C>34 – C50 (F4)	ug/g	50	<50	<50	<50	
Gravimetric Heavy Hydrocarbons	ug/g	50	N/A	N/A	N/A	
Moisture Content	%	0.01	11.3	5.8	6.1	-46.01%

The initial level of contamination is considered average or moderate and the normal expected remediation time is 4 weeks. The required time to meet and/or exceed the regulatory standard in this trial was 14 days. Though the other microbial product achieved good results, it would require an additional 7 to 14 days to complete the process and be under the regulatory threshold for all levels. This result reflects a minimum of a 33% shorter remediation time should the other product complete the process in an additional 7 days and as much as a 50% reduction in time if the other product required the entire 14 additional days. Currently, this facility can process approximately 650,000 cubic meters of material per year due to space limitation and time required to process the material and ship back out. If the facility could simply reduce the process time by 25%, the facility could increase the production by 162,500 cubic meters without any increase in facility size or capital expense. This would increase the total annual production capability for the facility to approximately 812,500 cubic meters a year.

Though time to process is very important for the ability for a facility to turn product around, cost to process the material is a more important factor that can be controlled. Certain microbial products including the likes of Nitro can vary per cubic meter depending on the region and area of the world being treated. The Soil Rx treatment continues to out perform all competitive products at a savings in excess of 27% savings versus their current processes.

The fact that current remediation production can increase by as much as 25% and material costs to achieve this performance is reduced by as much as 27% has truly impacted the cost of operations . We are also confident that material with higher levels of contamination will not require the same increase in microbial additive as is currently required and expect the overall time required to process any level of hydrocarbon contamination will continue to be significantly less.

With certain remediation sites exposed to cooling temperatures, SoilRX technology continues to seriously outperform all traditional bacterial only based technology. There is currently no product to our knowledge that has the efficacy and cost savings that SoilRX can offer.