Bioremediation Techniques on Crude Oil
Contaminated Soils in Ohio

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BIOREMEDIATION TECHNIQUES ON CRUDE OIL CONTAMINATED SOILS IN OHIO

Objective: The objective of this project is to develop environmentally-sound and cost-effective remediation techniques for crude oil contaminated soils. By providing a guidance manual to oil and gas operators, the Ohio Division of Oil and Gas regulatory authority hopes to reduce remediation costs while improving voluntary compliance with soil clean-up requirements. This shall be accomplished by conducting a series of field tests to define the optimum range for nutrient and organic enhancement to biologically remediate soils contaminated with brines and crude oil having a wide range of viscosity.

Summary of Technical Progress: Task Three of the bioremediation project resumed on June 17, 1996 with the first aeration of the site after a very wet spring season. Super fine lime was incorporated into the top 15 centimeters (six inches) of soil during three rotor-tillings. Although aeration proceeded according to the attached study chronology, samples could not be collected due to high soil moisture conditions until August 7, 1996. Results of the total petroleum hydrocarbon analysis revealed remediation was complete. Tri-14 fertilizer had been applied on July 8, 1996 at the rate of approximately 14/grams/.0929 meters² (½ oz./ft.²). Prior to receiving the August 7, 1996 sampling results, additional fertilizer had been applied at the same rate. Samples were collected on September 13, 1996 and analyzed for TCLP, BETX and chloride to assess the soil condition for closure of the study site. When results have been received Task Four of the project will be complete.

STUDY CHRONOLOGY

Task 3

1996

- June 14
 - Purchase (8) 18.1 kilogram (40 lb.) bags of superfine agricultural lime
- June 17
 - Till 18 plots for the first time since October 20, 1995
 - Till second time to incorporate weed growth
 - Soil moisture measured at 100% field capacity on all plots
 - Lime spread on all 18 plots at 113 grams/.0929 meter² (1/4 lb./ft.²)
 - Till third time to incorporate lime
- June 24
 - No field activity due to inclement weather
- July 1
 - No field activity due to inclement weather
- July 8
 - Till 18 plots to aerate soils
 - Collect field pH measurements
 - Triple-14 fertilizer spread on all 18 plots at approximately 14 grams/.0929 meter² (1/2 oz./ft.²)
- July 15
 - No field activity
- July 25
 - Till 18 plots to aerate soils
 - Rain gauge 7-8 to 7-25 51mm (2.0 inches)
- July 31
 - No field activity

Task 4

August 7

- Till 18 plots to aerate soils
 - Collect composite samples from five places on each half of 18 plots.

Thirty-six samples submitted to Wilson Laboratory for analyses of calcium, magnesium, sodium, conductivity, percent solids, total phosphates, pH and total petroleum hydrocarbons.
 - Triple-14 fertilizer spread on all plots at approximately 14 grams/.0929 meter² (1/2 oz./ft.²)
 - Rain gauge 7-25 to 8-7 15 mm (0.6")
- August 14
- Till 18 plots to aerate soils
 - rain gauge 8-7 to 8-14 18 mm (0.7")
- September 13
- Collect composite samples from five places on each half of 18 plots. Thirty-six samples submitted to Wilson Laboratory for analyses of BETX and TCPL metals.

Figure 1
New Arrangement of Remediation Plots

Crude Oil Contaminated Area

Pennsylvania Grade Crude Oil Plots 2, 4, 6, 8, 10 & 12	2	AW NM OY	4	AW NM ON	6	AW NH NM OY	8	AW NH NM ON	10	AM AW NM OY	12	AM AW NM ON
	1	AW NM OY	3	AW NM ON	5	AW NH NM OY	7	AW NH NM ON	9	AM AW NM OY	11	AM AW NM ON

Pennsylvania Crude Oil and Brine Contaminated Area

pH Maintained above 8	16	AW NM OY	18	AM NH NM ON	20	AM NH NM ON
pH Maintained below 7	15	AW NM OY	17	AW NH NM OY	19	AM NH NM ON

Legend of Variables on Each Plot

Aeration weekly AW
Nutrients monthly NM
Organic bulk added OY
Organic bulk not added ON

Figure 2

Field Measurements of pH and Percent Soil Moisture Capacity After Aeration

	pH	%	pH	%	pH	%	pH	%	pH	%	pH	%
7-8-96	5.5	100	6.5	100	6.5	100	6.5	100	6.5	100	7.0	100
	2		4		6		8		10		12	
7-8-96	5.5	100	6.5	100	7.0	100	7.0	100	7.0	100	7.0	100
	1		3		5		7		9		11	

	pH	%	pH	%	pH	%
7-8-96	7.0	100	7.0	100	6.5	100
	16		18		20	
7-8-96	6.5	100	7.5	100	7.0	100
	15		17		19	