

Cleanup of Contaminated Soils at Municipal Park

Introduction:

In recent years, the utility company has been targeted by vandals for thefts and damage to transformers resulting in spillage of transformer oil into the soil. Cleanup of these sites is the responsibility of the utility company and with the assistance of LACTEC a foremost research Institute in Curitiba, Brazil and Sarva Bio Remed, LLC, USA it was proposed to cleanup these sites at the site without the costs of transportation and disposal at the land fill sites as these facilities are not well established. The first task of the project was to develop a new product from the local sources and a new product AgroRemed BR CTBA was developed. All cleanup studies are being carried out with this product.

In March, 2006, in Fazenda Rio Grande, state of the Paraná, the vandals were responsible for the contamination of an area around 270 m² (2906 sq.ft) with transformer oil at the COPEL power electric transformer in the Municipal Park (Figure 1).



Figure 1. Contaminated soil of the Municipal Park.

Contamination of the soil appeared to extend to an area for 270 m² (visible) and the soil analyses, after one month, indicated the migration of the mineral oil as evidenced by the low concentrations on the surface, thus increasing the possibility of contamination of ground water. Tables 1 and 2 show the results of TPH in the soil.

Table 1. Surface Soil contamination after the accident (June of 2006).

Sample	Localization	Results
1	front to the pole	8309
2	next to the lake	3280
3	the left of the pole	5494
	Average	5694

Table 2. Surface Soil contamination one month after the accident (July of 2006).

Sample	Locality	Results
1	250° west of the tree	2006
2	behind the pole	802
3	the front of the construction	0
4	the left of the pole, 250° west of the tree, way	0
	Average	702
	General average	2842

COPEL as the responsible party for the cleanup, opted to the use of the bioremediation of the contaminated material by treatment with AgroRemed BR CTBA, a product consisting of local microorganisms developed by *Sarva Bio Remed*, USA in agreement with the environment laws in the country.

The new product AgroRemed BR CTBA, developed and imported at the end of 2006, could be used in all the Curitiba and adjacent regions in the Parana State.

In December of 2006, it was decided to carry out site remediation by excavating the contaminated soil to a depth of about 70 cm (2.5 feet) of depth and arrange the excavated soil in to piles for AgroRemed treatment and this was followed by regular monitoring and analyses in the laboratory. The soil analyses was carried out according to the international standard *ASTM D 5765-05 - Standard Practice for Solvent Extraction of Total Petroleum Hydrocarbons from Soils and Sediments Using Closed Vessel Microwave Heating*.

Excavation of Contaminated Soil

Initially it was considered to treat 270 m² visible area, to a depth of 3 meters, however due to delay in treatment there was an increase of the surface area by 80 m² to a total of 350 m² (3767 square feet) of contaminated soil because of the lateral migration of the spill. Initial analytical inspection showed that the percolating of the mineral oil was restricted to about only 40 cm depth.

In order to prevent the removal of uncontaminated soil and to reduce the volume of material to be treated, the excavations were made of ditches at different depths and evaluated the levels of contamination. Initially, the excavated area was divided in 6 squares (Figure 2). A preliminary analysis indicated that soil should be removed up to 50 cm but then it was decided to that the excavations would be continued till the TPH value reaches below 50 mg of oil for kg of soil. (Tables 3, 4, and 5)



Figure 2. Excavation of the contaminated soil.

Table 3. Results of TPH analysis of the ditches the 50 cm.

Points	Locality	Preliminary result (ppm)
1	end of 4° quadrant	399
2	beginning of 3° quadrant	37
3	front to the pole	220
	Average	219

Table 4. Results TPH analyses for the ground excavated at 50 cm depth.

Point	Locality	Results (ppm)
1	Next to stacks in line of the pole	0
2	At the Pole	646
3	1° quadrant to the pole	0
4	3° quadrant to the pole	388
5	4° quadrant to the pole	0
6	5° Quadrant to the pole	40
	Average	179

Table 5. Results of the TPH analyses for ground excavated the 70 cm.

Point	Locality	Results
1	1° quadrant to the left	0
2	3° quadrant to the left	0
3	4° quadrant to the left	0
4	5° quadrant to the left	144
	Average	36

The analysis of the soil samples results of the soil near 70 cm, showed an average value of 36 ppm, which was lower than the stipulated value 50 mg/Kg. so further excavations were discontinued. A total of 10 piles/stacks of soil were treated with AgroRemed BR CTBA.

b. Remediation of the Contaminated Material

The soil excavated in the previous four stacks was spread on impermeable canvas and samples were collected and sent for analysis of Total Petroleum Hydrocarbons before the beginning of the treatment. Collected the samples, the process of material remediation were initiated. AgroRemed BR CTBA was sprayed on the four stacks of the excavated soils periodically mixing the soil for better the contact with all the soil in the stacks. The Table 6 shows the values of TPH before the treatment and Figure 4 shows the application of AgroRemed BR CTBA.

Table 6. Result of the TPH analyses in the ground before the treatment.

Average - Stacks before the treatment				
Stacks	1	2	3	4
Surface	3397	1938	2947	1530
Middle	1167	1877	821	887
Deep	501	2946	995	876
Average	1688	2254	1587	1098
			General Average	1657



Figure 3. Application of AgroRemed BR CTBA to piles/stacks.

After two weeks of remediation samples of soil were sent to the LACTEC laboratories for analysis and to see if the values had reached below 50 mg/kg and the results are given in Table 7 below.

Table 7. Value of TPH after 2 weeks of treatment

Average - Stacks after 2 weeks of treatment				
Stacks	1	2	3	4
Surface	521	750	599	560
Middle	1087	966	399	330
Deep	675	528	450	525
Average	761	748	483	472
			General Average	616

It can be seen from the results that there was a reduction of 63% in the value of TPH during the period of 2 weeks is very significant. Fresh addition of the AgroRemed was done and the results are seen in the Table 8 below.

Table 8. Result of TPH analyses in the ground after 6 weeks.

Average - Stacks after 6 weeks of treatment				
Stacks	1	2	3	4
Surface	829	349	389	443
Middle	641	728	741	438
Deep	456	592	381	250
Average	642	556	504	377
			General Average	520

There was no appreciable reduction in the TPH which is attributed to the nature of the soil and possible dry conditions during the period. More application of AgroRemed was made and the soil was mixed periodically to allow greater contact with product and the results of the soil after 10 weeks of treatment are given in Table 9 below. The results show almost 90% reduction in the TPH values before the treatment.

Table 9. Result of TPH analyses in the ground after 10 weeks.

Average - Stacks 10 weeks of treatment				
Stacks	1	2	3	4
Surface	3	27	146	14
Middle	30	748	76	24
Deep	170	1391	379	166
Average	68	722	200	68
			General Average	265

The process of the treatment was extended to the remaining stacks and the results are given below in Tables 10 and 11.

Table 10. Result of TPH analyses in the ground before the treatment.

Average - Before the treatment						
5	6	7	8	9	10	Average
41	435	635	395	496	485	1341
9	432	403	266	317	316	698
80	583	629	355	1328	680	937
43	483	556	339	714	494	438
					Gen. Average	438

Table 11. Result of TPH analyses in the ground after 2 weeks.

Average - After 2 weeks of treatment						
5	6	7	8	9	10	Average
293	156	136	179	87	156	168
231	64	136	329	350	133	207
292	167	145	255	109	467	239
272	129	139	254	182	252	205
					Gen. Average	205

In order to close the project as per the environment laws of the country, the soil was analyzed for TPH, Benzene, Toluene, Xylene and PAH as shown in Table 12. The results indicated the values of these parameters within the accepted values. The ditches were closed with the treated soil and the project was closed as No Further Action required and the area was released for normal use for the Municipal Park (Figure 4).

Table 12. Results of TPH, BTX and HPA for each one of the stacks.

Stack of treatment	TPH (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Xylene (mg/Kg)	PAH (mg/Kg)
1	55	< 0,5	< 0,5	< 0,5	< 2,0
2	485	< 0,5	< 0,5	< 0,5	< 2,0
3	184	< 0,5	< 0,5	< 0,5	< 2,0
4	313	< 0,5	< 0,5	< 0,5	< 2,0
5	0	< 0,5	< 0,5	< 0,5	< 2,0
6	14	< 0,5	< 0,5	< 0,5	< 2,0
7	113	< 0,5	< 0,5	< 0,5	< 2,0
8	74	< 0,5	< 0,5	< 0,5	< 2,0
9 and 10	40	< 0,5	< 0,5	< 0,5	< 2,0
Average	142	< 0,5	< 0,5	< 0,5	< 2,0



Figure 4. Area refilled with the treated soil and is now open for public

Conclusion: The cleanup was completed in 4 months of time using AgroRemed BR CTBA on soil excavated soil at the site. After the results showed reduction in values of TPH and Benzene, Toluene, Xylene and PAH as per the values stipulated by the environment agency, the soil was reused for filling up the excavations. The quantity of AgroRemed used was 700 liters to treat 225 tons of soil or 3.1 liters per 1 ton of soil contaminated with transformer oil.