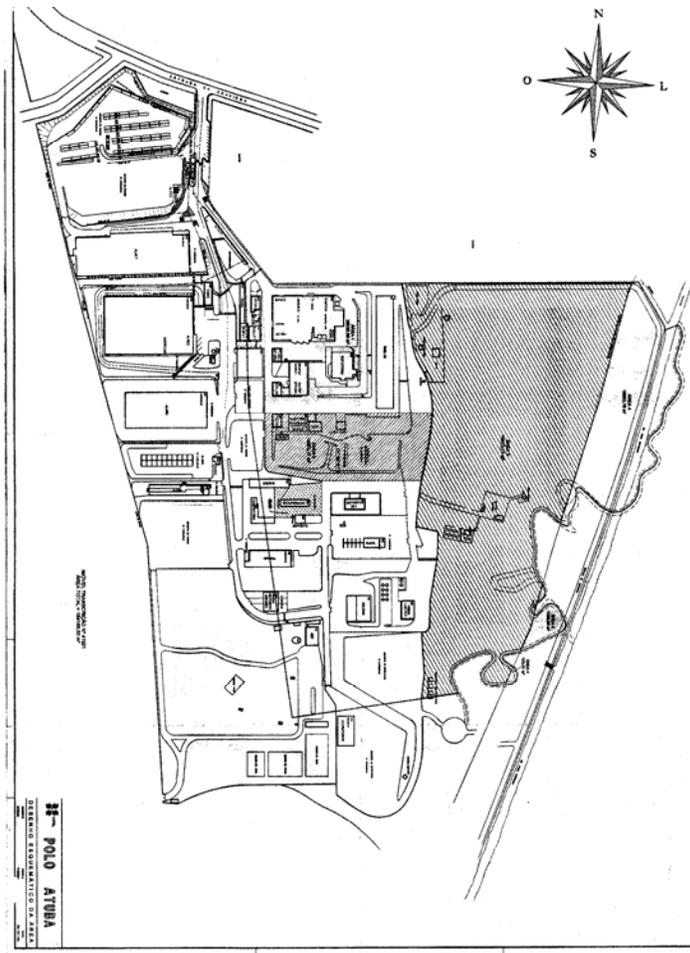


Bioremediation of petroleum contaminated
Soils in Brazil Using AgroRemed

Introduction

A large utility company of Brazil responsible for the supply and maintenance power in the region of the Atuba. This area adjoins old stream bed of River Atuba that joins currently the limit of the property of the Utility Company with the urban area. The edges of River Atuba are classified as "Area of Permanent Protection" (APP), and hence required stringent environment conditions. However, the area is heavily contaminated with years of misuse of the oily wastes dumped at the site. It is necessary to cleanup the contaminated oils and protect the river from pollution.



The above aerial view of the site representing 18,400 m² area that requires to be cleaned up using AgroRemed bioremediation product to reduce the TPH to acceptable levels.

SELECTION CRITERIA

AgroRemed is manufactured by Sarva Bio Remed, LLC, an environmental biotechnology company of Trenton, New Jersey, U.S.A. The product has been selected on the basis of the following criteria:

- Available in a ready to use form
- Non invasive treatment
- Will not disturb the ecology of the area
- Satisfy local environmental concerns
- Will not destroy existing plants

The Sarva Bio Remed, LLC is also a partner in the execution of this project; contribute to the development of the specific remediation treatment protocol for the project.

ENVIRONMENTAL SAFETY CONCERNS

During the presentation made by us at Curitiba in March, 2005, scientists and students from the state environment agencies and some environment groups raised a few concerns about the project as Parana state has pristine forests and precious plants typical of the state which are protected by the state. We outline the concerns and our approach to addressing them:

Will there be any excavations?

Bioremediation of the petroleum contaminated soils using AgroRemed is a non-invasive treatment and hence the soil will not be excavated. Treatment with AgroRemed will be carried out using such engineering processes that will allow on-site treatment of the contaminated soils without extensive excavations.

Will the existing vegetation be destroyed during treatment?

No the vegetation will not be destroyed. AgroRemed is a bioremediation product and hence it is non-toxic to the existing vegetation. Earlier studies have shown that AgroRemed not only cleaned up hydrocarbons but they also made the soil as fertile as it was prior to the contamination.

Will the process be toxic to the existing vegetation?

The bioremediation products developed by Sarva Bio Remed, LLC have been found to promote development of ecosystems that has been destroyed due to the toxicity of the hydrocarbons. In one of the studies, the water containing waste oil was remediated and

resulted into water free from toxic effects of the oils. This was evidenced by the sudden increase in population of protozoan, variety of ciliates and algae.

Will the project affect the ecosystem of the area?

No. Use of AgroRemed will not affect the ecosystem existing in the soil. The populations killed by toxic effects of the hydrocarbons cannot be revitalized, however, the populations surviving the toxic effect will be provided with conditions favoring better growth.

Will it affect the fertility of the soil?

The bioremediation treatment of the soils at Atuba is expected not only to remove the toxic effects of the hydrocarbon oils, but also improve the fertility of the treated soils. In one of the recent studies an area of a lawn that was destroyed by diesel spill, was rejuvenated by additions of AgroRemed and fresh lawn grass began growing as before.

What are the after effects on the overall ecosystem of the entire area?

Treatment with AgroRemed to soil will have not adverse impact on the soil and associated ecosystems. AgroRemed promotes a healthy growth of both plant and animal life by detoxifying the effects of hydrocarbons. This has been observed with all other bioremediation products developed both for marine and terrestrial applications.

SITE ANALYSIS

TPH Content for soil samples are shown below; this document captures the information about site marked S11, which is one of the hotspots.

Sample No.	Location	Surface	1 Meter Below	2 Meter Below
1	S7 + 140	0	709	663
2	S6 + 140	1155	697	380
3	S5 + 140	187	148	448
4	S4 + 140	815	738	935
5	S3 + 140	475	190	470
6	S7 + 160	2360	1471	567
7	S6 + 160	1037	1126	1606
8	S5 + 160	48820	1149	1778

9	S4 + 160	0	0	745
10	S3 + 160	1491	176	306
11	S6 + 180***	400	766965	637
12	S6 + 200	1270	1175	1099
13	S1 + 140	941	289	258
14	S5 + 180	669	287	349
15	S5 + 200	579	119	208
16	S4 + 200	664	257	301
17	S3 + 180	698	758	799
18	S2 + 120	2278	349	617
19	S3 + 200	1350	1243	1893
20	S4 + 180	950	359	608
21	S1 + 180	936	987	1199
22	S7 + 180	1624	1204	4067
23	S7 + 200	745	550	5874
	Total	69444	779192	25807
	Average TPH	3019	33878	1122

Summary of Analyses	
Number of Samples	69
Total (TPH in ppm)	876197
Site Average (TPH in ppm)	12699

*** = Current treatment site: the hot spot.

DESIGN FOR TREATMENT

The results of soil samples have shown that the highest values of TPH have been recorded in soils between 1 and 2 meters. On the basis of the analysis, the first site selected for cleanup is the site No. S6 - 11 as that has shown the highest value of TPH. In order to clean the soil without any excavation, it has been planned to design several subterranean canals for pumping water through the deeper layers of soil and removing the contaminating oil.

The engineering construction of the canals and setting up of holding tanks has been completed. The system is undergoing extensive evaluations to ascertain that the rate of pumping of the wash water progresses at a predetermined rate.



PLATE 1. SHOWING THE CONSTRUCTION OF PERMEATION CANALS AT THE SITE FOR EFFICIENT PUMP & TREAT PROCESS



PLATE 2. INSTALLATION OF MONITORING WELLS



PLATE 3. LAYING OF PIPE FOR PUMPING WATER/AGROREMEDIATION



PLATE 4. IRRIGATION CANALS, MONITORING WELL AND THE UNDISTURBED VEGETATION AT THE SITE.



PLATE 5. HOLDING TANKS FOR COLLECTION OF WASH WATER FOR FURTHER TREATMENT TO REDUCE TPH LEVELS TO ACCEPTED VALUES BEFORE DISCHARGE.

Phase 2: Results of 2007

Results of the Phase 1 of the project were received in June 2007. The contour map of contamination levels in the soil is given below.

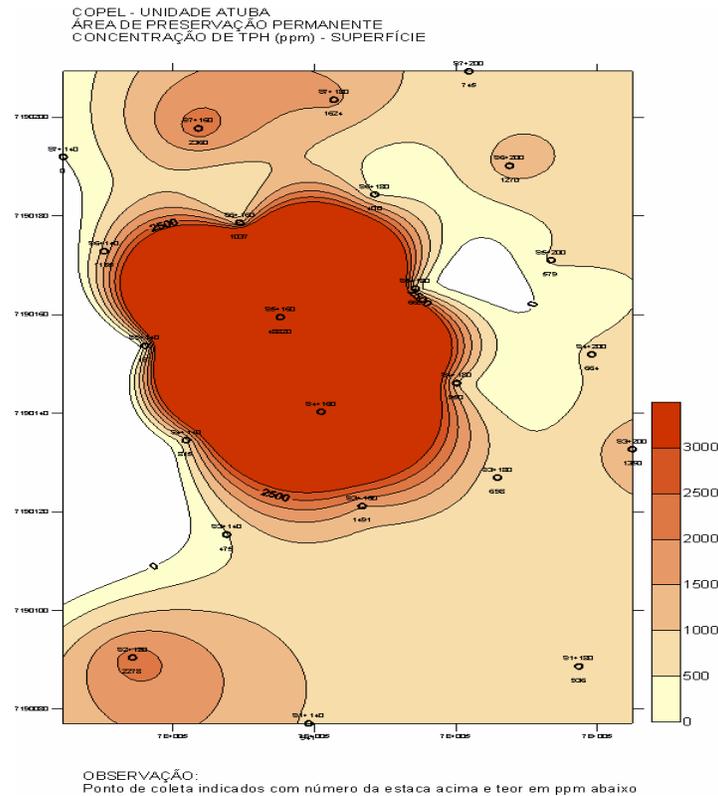


Plate 6. TPH Contour map

The treatment of soil effluent was carried out during the early period of 2007 due to drought conditions in 2006. The treatment was carried out in the drums adding product developed both in the USA and also one developed for Curitiba Brazil as shown in figure below. 400 liters of AgroRemed was used for the pump and treat process. Water collected in the collection troughs was pumped into the drums shown in Figure above.

The water was treated with AgroRemed till the oil concentration was below the acceptable levels and discharged after passing through the sterilizing chamber based on the bacterial count. Figure below shows the emulsification of transformer oil before final consumption of the oil. Soil was analyzed once again and values of TPH were determined before and after treatment.



Plate 7. Treatment with AgroRemed in progress

Point	Surface	1 meter	2 meter	Average
S5+160	48820	1149	1778	17249
S3+200	1350	1243	1893	1495
S7+200	745	550	5874	2390
S6+180	400	766965	637	256001
S2+120	2278	349	617	1081

Table 2. Values of TPH at the hot spots before treatment.

Point	Surface	1 Meter	2 Meter	Average
S5+160	92	113	585	263
S2+120	490	774	12	425
S3+200	741	344	73	386
S6+180	89	72	32	64
S7+200	4	91	0	32

Table 3. Values of TPH after treatment at the same spots.

Results of the first treatment schedule are very promising. One more sampling of the area is in progress to determine the existing values before continuing with the treatment.