

ENVIRONMENTAL AUDIT OF THE SITES IMPACTED BY THE “PROBO KOALA” TOXIC WASTE DUMPING IN ABIDJAN, CÔTE D'IVOIRE



This series of fact sheets was prepared as part of UN Environment's environmental audit of the sites impacted by the “Probo Koala” toxic waste dumping in Abidjan, Côte d'Ivoire. The fact sheets provide complete analysis results, observations and the recommendations for each of the sampling sites. They should be read in conjunction with the full assessment report, available at: www.unep.org/CotedIvoire

SITE 9: ALÉPÉ 1

Site Description

Site name: Alépé 1

UN Environment site reference no: 9



Spill History

This site is a large open area adjacent to the main road linking Abobo and Alépé, located near the village of Djibi. Wastes from the Probo Koala are reported to have been dumped down an embankment from the roadside, and to have flowed downstream across the site.

Alépé 1 was the centre of multiple clean-up operations, starting with partial excavation by Trédi in the months following the dumping event. Further excavation was undertaken between September 2007 and March 2008 by Biogénie, then contracted directly by Trafigura; contaminated materials were stored on site in big bags.

Starting in 2010, Biogénie was contracted by the Government to conduct additional and complementary clean-up, which included finalizing excavation and treating contaminated soils – from Alépé 1 and 2, as well as some other sites – using biological activation techniques. It is reported that the site was excavated down to a depth of 14 m in some locations, and that some 16,000 tons of soil were treated here. Following some delays due to the post-electoral violence in 2010-2011, the bio-remediation process at Alépé was considered to be completed by end 2014. The treated soil was then redistributed across the site in 2015.

Approach

The following five soil samples were obtained from the south-west portion of the site, in close proximity to the adjacent road, where it was reported that the Probo Koala wastes were dumped:

- Two composite surface (0-20 cm) soil samples; and
- Three 1 m-depth soils samples, of which the third was taken approximately 50 m north of the other two.

In addition, one air sample and one sample of comestible vegetation (cassava) were collected at the site.

Assessment Criteria

Based on the different analyses of the chemical composition of the samples taken onboard the Probo Koala in 2006, as well as those undertaken on samples collected on the dumping sites, UN Environment considered the following groups as the key contaminants of interest for the audit:

- Petroleum hydrocarbons;
- Sulfur compounds; and
- Heavy metals.

The speciation of contaminants to be analyzed within the above three groups was primarily determined by what was present in the Probo Koala waste as well as the environmental standards set by the Government of Côte d'Ivoire for clean-up. In addition, the impact of high levels of sodium hydroxide was measured through the pH value of the soil.

The results obtained from the analyses of **soil** samples were screened according to the following process:

1. Findings were first compared with relevant national standards. In this case, results for soil from all the sites where Probo Koala wastes were dumped and which had undergone remediation were compared with the environmental standards set by the Government of Côte d'Ivoire for clean-up operations conducted by Biogénie at Alépé. If the values obtained were lower than the standards set by the Government, UN Environment considered that no additional clean-up intervention was necessary on the site.

- If laboratory results for a given parameter showed values exceeding the clean-up standards set by the Government or contractor, results were then compared with the internationally recognized Dutch soil remediation standards (intervention values) to see if further immediate action was needed from an environmental point of view. Dutch standards have been in existence for over 30 years and are used as a basis for contaminated site assessment and clean-up in many parts of the world, when local standards are not available. For most parameters of analysis, however, the Government's clean-up standard was more stringent than the Dutch values.
- Results were also compared with the control sites to see if the observed pollution was also present in the background.

For air quality analysis, for which no national standards exist in Côte d'Ivoire, the approach taken was to compare air quality results from the affected sites with Control Site 21.

Fruit and vegetable samples were tested using similar protocols as those used for analysis of soil and water samples. In the absence of national food quality standards, the European Commission's maximum levels of certain contaminants in food stuffs (EC regulation 1881/2006) are used for comparison. It should be noted that as it was found that there were interferences from naturally occurring substances with the hydrocarbon analyses, the analytical results relating to hydrocarbons were discarded.

Laboratory Analysis Findings

Soil Parameters (mg/kg)	Site 9 Alépé 1					Government standard (mg/kg)
	0-20 cm	1 m	0-20 cm	1 m	1 m	
Total Hy C5-C44	1.02	1.64	< 0.1	4.33	< 0.1	1,000
Benzene	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	1
Ethylbenzene	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	25
Toluene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	5
Xylene	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	5
Total sulfur (%)	< 0.02	0.157	< 0.02	< 0.02	0.0218	10
Pb	3.7	5.7	2.4	7.2	11	400
Cd	< 0.1	< 0.1	< 0.1	0.1	0.1	20
As	1.4	1.8	0.95	2.5	4	37
Cr	18	22	13	32	51	130
Ni	1.8	2.2	0.89	3	4.4	140
Co	0.37	0.47	0.18	0.55	0.81	240
Hg	0.022	0.038	0.009	0.045	0.043	7
Cu	1.8	2.3	0.93	2.2	2.5	190
Zn	6.1	7.5	3.2	8.2	10	9,000
pH	5.01	5.68	5.76	5.27	4.11	

Air		Site 9	Control site 21
Parameters/units		Alépé 1	Agboville
Dimethyl sulfide	ppm v/v	< 0.1	< 0.1
Ethyl mercaptan	ppm v/v	< 0.1	< 0.1
Methyl ethyl sulfide	ppm v/v	< 0.1	< 0.1
Carbonyl sulfide	ppm v/v	< 0.1	< 0.1
Tertiary butyl mercaptan	ppm v/v	< 0.1	< 0.1
Hydrogen sulfide	ppm v/v	< 0.1	< 0.1
Methyl tert-butyl ether	µg/m3	ND	ND
Benzene	µg/m3	ND	ND
Toluene	µg/m3	11	ND
Ethylbenzene	µg/m3	ND	ND
Xylene	µg/m3	ND	ND
Naphthalene	µg/m3	ND	ND
TPH (C4-C6)	µg/m3	ND	10
TPH (C6-C8)	µg/m3	20	20
TPH (C8-C10)	µg/m3	53	35
TPH (C10-C12)	µg/m3	42	53
TPH (C4-C12)	µg/m3	39	120
Aliphatic (C4-C6)	µg/m3	150	ND
Aliphatic (C6-C8)	µg/m3	20	17
Aliphatic (C8-C10)	µg/m3	40	31
Aliphatic (C10-C12)	µg/m3	31	53
Aromatic (EC5-EC7)	µg/m3	37	ND
Aromatic (EC7-EC8)	µg/m3	ND	ND
Aromatic (EC8-EC10)	µg/m3	11	ND
Aromatic (EC10-EC12)	µg/m3	ND	ND

Fruit and vegetable Parameters (mg/kg)	Site 9	Control site 21	EC regulation (mg/kg)
	Alépé 1 Manioc	Agboville Grenade	
Total sulfur (%)	< 0.02	0.0547	
PAH	< 0.118	< 0.118	
Pb	< 0.7	< 0.7	0.1
Cd	< 0.02	< 0.02	0.1
As	< 0.6	< 0.6	
Cr	< 0.9	1.62	
Ni	< 0.2	0.82	
Co	< 0.1	0.149	
Hg	< 0.14	< 0.14	
Cu	1.9	3.85	
Zn	17.6	22.9	

Conclusions and Recommendations

The laboratory results show that the current concentrations of the contaminants of concern in soil are all below the standards set by the Government of Côte d'Ivoire for clean-up. Likewise, hydrocarbon levels in the sample analyzed are well below Dutch intervention values. Furthermore, the pH values are not in the caustic range (9 or above), demonstrating that the impact of the disposal of caustic substances can no longer be detected. No further action is therefore needed on this site to remediate the soil impacts of the 2006 toxic waste dumping from the Probo Koala.

The results of the air quality analysis can be summarized as follows:

- Mercaptans, hydrogen sulfide and related components cannot be detected in this site, nor the control site. This is significant considering that the key odorants in the Probo Koala wastes were most likely hydrogen sulfide and mercaptans.
- Concentrations of the various analytes at the affected site are comparable to the concentrations found at the control site.

Based on the fruit and vegetable results, the following observations can be made:

- All samples, including the pomegranate sample from Control Site 21 at Agboville, show the presence of various analytes and heavy metals. Fruits and vegetables naturally accumulate heavy metals from the soil. As most of the heavy metals are essential to human health in small quantities, their uptake through fruits and vegetables is not considered to be a risk.
- The EC standard for lead is below the detection limit of the laboratory analyses. However, considering that all samples, including control samples, show comparable heavy metal values, these results are not considered to warrant further follow up.

Site Photos



Source: UN Environment



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