SITE 11: AKOUÉDO 1

UN environment

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

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Site Description

Site name: Akouédo 1
UN Environment site reference no: 11

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Spill History

This spill site is located within Abidjan's municipal waste disposal site at Akouédo, in an area that is currently not actively used. Wastes from the Probo Koala are reported to have been dumped into the ditch running parallel to the dirt road that traverses the vast waste disposal grounds. During clean-up operations by Trédi in 2006-2007, contaminated materials were excavated and removed for off-site treatment, and the remaining void back-filled with clean soil. At the time of sampling, small, informal plantations of food crops, such as banana, maize, papaya and gombo, could be seen growing on either side of the dirt road.

Approach

One composite surface (0-20 cm) soil sample was taken approximately 5 m from the track, on the far side of the drainage ditch, where the soil was covered with a layer of refuse.

In addition, one air sample and one sample of comestible vegetation (melon) were collected on 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.

2. 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.

3. Results were also compared with the control sites to see if the observed pollution was also present in the background.

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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, some 69 km away from Abidjan near Agboville, where the impact of the urban pollution was expected not to be felt.

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 11 Akouédo 1 0-20 cm	Government standard (mg/kg)
Total Hy C5-C44	180	1,000
Benzene	0.0102	1
Ethylbenzene	< 0.003	25
Toluene	0.00224	5
Xylene	< 0.00936	5
Total sulfur (%)	0.0388	10
Pb	220	400
Cd	1.9	20
As	7.9	37
Cr	61	130
Ni	30	140
Co	4	240
Hg	0.27	7
Cu	97	190
Zn	390	9,000
pH	7.34	

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Air Parameters/units		Site 11 Akouédo 1	Control Site 21 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	ND	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	40	20
TPH (C8-C10)	µg/m3	31	35
TPH (C10-C12)	µg/m3	66	53
TPH (C4-C12)	µg/m3	63	120
Aliphatic (C4-C6)	µg/m3	200	ND
Aliphatic (C6-C8)	µg/m3	40	17
Aliphatic (C8-C10)	µg/m3	27	31
Aliphatic (C10-C12)	µg/m3	57	53
Aromatic (EC5-EC7)	µg/m3	62	ND
Aromatic (EC7-EC8)	µg/m3	ND	ND
Aromatic (EC8-EC10)	µg/m3	ND	ND
Aromatic (EC10-EC12)	µg/m3	ND	ND

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Fruit and vegetable Parameters (mg/kg)	Site 11 Akouédo 1 Melon	Control site 21 Agboville Pomegranate	EC regulation (mg/kg)
Total sulfur (%)	0.0612	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	3.55	1.62	
Ni	4.43	0.82	
Co	0.307	0.149	
Hg	< 0.14	< 0.14	
Cu	13.7	3.85	
Zn	52.9	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 analysed 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.

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Site Photos

Source: UN Environment

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