Lead Contamination at an Abandoned Lead-Acid Battery Recycling Facility in the Dominican Republic

(A Preliminary Report)

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I. Background

The residential community of Paradiso de Dios in the city of Haina west of Santo Domingo is home to an abandoned used lead-acid battery (ULAB) recycling facility. High blood levels were identified in children and adults living adjacent to this ULAB site in 1996 (Kaul et al)\(^1\) and the site was force to cease operations shortly thereafter. In early 2006, a team from Blacksmith Institute and Hunter College visited the site for purposes of quantifying lead soil concentrations at and adjacent to the site. As a result of the confirmed high blood lead levels, extensive lead contamination and its continuing threat to public health; Blacksmith Institute voted to put this site on its list of “World’s Worst Polluted Places”\(^2\).

Recently, (March 2007) a team from Hunter College and Blacksmith Institute revisited Paradiso de Dios in Haina, Dominican Republic for the purpose of quantifying lead in household dust in homes adjacent to the abandoned ULAB recycling facility.

The report presents the results of lead in soil and household dust taken during these visits. Blood lead levels in community children taken during the 2007 sampling are not report in this document.

II. Methods

Collection of Soil Samples

Surface soil samples were collected from two areas; directly at the waste site and perimeter sampling. The on-site sampling was conducted by visually dividing the site into 12 quadrants and taking a surface soil sample from each quadrant. Perimeter sampling was done primarily in residential backyards of homes adjacent to the ULAB site. As per standard guidelines for soil testing, the top 2 centimeters of soil were collected and packaged in plastic 50 ml centrifuge tubes.

Collection of Household Dust

Household dust samples were collected in 13 homes adjacent to the ULAB site and 12 homes in the center of downtown Haina (approximately 1.5 km away). The lead dust sampling protocol followed US HUD Guidelines.

Dust was collected at two sites in each home; the living area and child’s bedroom. Using specialized dust wipes and wearing disposable latex gloves, approximately 1-3 square feet of floor surface was wiped at each site. Samples were package in...
clean containers and labeled. Standard Housing and Urban Development (HUD) lead dust wiping techniques (Appendix 13.1 HUD Guidelines) were employed. The wipes (Ghost Wipes™) complied with the ASTM E 1792-96E guideline.

Analytical Method
All samples were packaged and brought to the US for analysis and sent to an AIHA/ELLAP accredited commercial laboratory. Samples were prepared following HUD Appendix 14.2 Guidelines. Flame atomic absorption / Spectrophotometry (EPA Method 7420) was used to quantify lead in the soil and dust samples.

III. Results and Interpretation

A. Lead in Soil at Paradiso de Dios

Table 1 reports on the lead in soil samples within the abandoned ULAB site and in residential backyards adjacent to the site (perimeter sampling). The US lead in Soil guideline for bare soil with potential childhood contact is set at 400 parts per million or micrograms per gram (ug/g).

Table 1:
Lead in Soil Levels at the Abandoned Waste Site and in Adjacent Residential Yards at Paradiso de Dios

<table>
<thead>
<tr>
<th></th>
<th>Abandoned ULAB Waste Site</th>
<th>Residential Yards (Perimeter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of samples</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Median Lead Level- ppm**</td>
<td>55,420</td>
<td>11,225*</td>
</tr>
<tr>
<td>High – ppm</td>
<td>463,970</td>
<td>60,560</td>
</tr>
<tr>
<td>Low - ppm</td>
<td>11,400</td>
<td>160</td>
</tr>
<tr>
<td>75% percentile</td>
<td>285,473</td>
<td>24,608</td>
</tr>
</tbody>
</table>

* probability < 0.007  
** median values reported due to log normal distribution of data

The median lead level at the ULAB site was 55,420 parts per million. This can also be expressed as 5.54% lead by weight. A level of over 100 times the US EPA lead in soil standard. An extraordinarily high lead soil level of 463,970 was found and translates to 46.4% lead. In essence, approximately ⅓ of this sample was pure lead metal.

The lead levels at the perimeter sites were also quite high with a median value of 11,225 ppm or 1.12% lead by weight. Only one sample was below the US EPA guideline of 400 ppm was found (160 ppm). Essentially 23 of 24 samples taken from both sites exceeded the US EPA guideline. Despite the very high levels at each site, the residential yards were shown to have statistically lower lead in soil levels than the ULAB waste site.
B. Lead in Household Dust at Paradiso de Dios and a Control Neighborhood

Table 2 reports on the lead in dust samples in homes adjacent to the abandoned ULAB site and in a control residential neighborhood distant to the site. The US EPA lead in floor dust guideline is 40 micrograms per square foot or ug/sf. Data analysis revealed that bedroom floor lead levels were not statistically different than living room results. For this reason the data represented in Table 2 averages the bedroom and living room dust wipe values.

Table 2:
lead in Household Dust Adjacent to the ULAB site and a Control Neighborhood

<table>
<thead>
<tr>
<th></th>
<th>Homes adjacent to ULAB site</th>
<th>Control Neighborhood</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of samples</td>
<td>12*</td>
<td>12</td>
</tr>
<tr>
<td>Mean Dust Lead (ug/sf)</td>
<td>64.3</td>
<td>9.7*</td>
</tr>
<tr>
<td>High</td>
<td>156.6</td>
<td>35.1</td>
</tr>
<tr>
<td>Low</td>
<td>2.9</td>
<td>1.8</td>
</tr>
<tr>
<td>75% percentile</td>
<td>100.2</td>
<td>9.8</td>
</tr>
</tbody>
</table>

* One reading deleted, see write up
** Probability = 0.00075

One home was eliminated from the analysis due to its very high interior dust lead level. This home reported a remarkably high living room floor value of 1,814 ug/sf and a bedroom value of 872 ug/sf. Inclusion of this result would skew the data analysis. However, given the small number of homes tested, it is quite possible this result was not an anomaly and may be indicative of scattered hot spots throughout Paradiso de Dios.

As Table 2 reports, the mean lead in floor dust level in homes in Paradiso de Dios exceeded the US EPA standard and 75% of the samples had values less that 100.2 ug/sf. In comparison, no samples in the control neighborhood exceeded the US EPA standard with the highest value at 35.1 ug/sf. Figure 1 graphically presents the distribution of lead in floor dust levels at both sites.
Figure 1:
Lead in House Dust (micrograms per square foot), Haina, DR

IV. Summary

The toxicity of lead and its impact on young children is well studied and widely published. Recent studies have determined that intellectual impairment occurs at blood lead levels less than 10 μg/dl; a level previously thought to be safe. In order to decrease the incidence of childhood lead poisoning, it is imperative to determine and control the exterior sources of lead that are consistently observed in our environment.

The neighborhood of Paradiso de Dios in the city of Haina continues to present a significant lead risk hazard to the adjacent residential community. Soil lead levels taken last year were orders of magnitude greater than allowable US EPA standards. Recent interior dust wipes of actual residences adjacent to the abandoned ULAB confirm continuing lead contamination.

Despite the limitations of this sampling, it is clear that the uncontrolled waste site and the surrounding area are the active source of an elevated blood lead risk. We recommend additional site characterization to better understand the remediation scope necessary to address this serious threat to childhood health.
References

1 Balkrishena Kaul, Randhir S. Sandhu, Conrado Depratt, and Franklin Reyes’ Follow-Up Screening of Lead-Poisoned Children Near an Auto Battery Recycling Plant, Haina, Dominican Republic, Environmental Health Perspectives Volume 107, No 11, Nov 1999


4 EPA Lead (Atomic Absorption, Direct Aspiration); Method 7420. EPA Test Methods Chapter 3.3:7420-1-7420–4. 1986

5 Centers for Disease Control, Preventing Lead Poisoning in Young Children. A statement by the Centers for Disease Control. 4th rev. Atlanta GA Centers for Disease Control: US Department of Health and Human Services/Public Health Service 1991