Hazardous occupational and community exposures in informal e-waste recycling

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Economic considerations

Table 1. Hierarchical structure of e-waste from Agbogbloshie.

<table>
<thead>
<tr>
<th>Role in E-Waste Circuitry</th>
<th>Estimated Average Monthly Income (USD) *</th>
<th>Percent of Ghanaian Daily Minimum Wage *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Firm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>International Firm</td>
<td>$20,000+</td>
<td>N/A</td>
</tr>
<tr>
<td>Scrap Dealer</td>
<td>$1500</td>
<td>2747%</td>
</tr>
<tr>
<td>Middleman</td>
<td>$1050</td>
<td>1923%</td>
</tr>
<tr>
<td>Refurbisher</td>
<td>$190–$250</td>
<td>348%–458%</td>
</tr>
<tr>
<td>Recycler</td>
<td>$175–$285</td>
<td>321%–522%</td>
</tr>
<tr>
<td>Scrap Collector</td>
<td>$70–$140</td>
<td>128%–256%</td>
</tr>
<tr>
<td>Child Laborer</td>
<td>≤$20</td>
<td>≤36.6%</td>
</tr>
</tbody>
</table>

Increasing benefit

Increasing population

“Typical” e-waste exposure study

TABLE 1. Limit of Quantification and Mean and Ranges of Concentrations⁹ (ng/g dry wt) for Individual CIPAHs in Electronic Shredder Waste, Leaves, Floor-Dust, and Soil Samples from an e-Waste Recycling Facility, a Chemical Industrial Complex, and from Other Locations

<table>
<thead>
<tr>
<th>compound</th>
<th>LOQ (ng/g)</th>
<th>electronic shredder waste</th>
<th>leaf</th>
<th>floor-dust</th>
<th>soil</th>
<th>urban soil (reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9,10-CIPhe</td>
<td>0.06</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>9-CPhe</td>
<td>0.13</td>
<td>0.52 (0.46–0.59)</td>
<td>7.75 (1.21–15.5)</td>
<td>3.72 (2.4–5.09)</td>
<td>0.49</td>
<td>ND (0.56)</td>
</tr>
<tr>
<td>2-ClAnt</td>
<td>0.14</td>
<td>13.2 (6.28–20.4)</td>
<td>4.34 (1.27–7.08)</td>
<td>8.49 (1.31–15.9)</td>
<td>1.25</td>
<td>ND (0.69)</td>
</tr>
<tr>
<td>3,4-ClPhe</td>
<td>0.15</td>
<td>14.9 (7.68–26.7)</td>
<td>27.7 (15.2–44.8)</td>
<td>16.6 (6.86–31.8)</td>
<td>4.05</td>
<td>ND (1.10)</td>
</tr>
<tr>
<td>1,2,3,10-CIPhe</td>
<td>0.14</td>
<td>4.83 (4.10–6.30)</td>
<td>7.00 (2.73–11.7)</td>
<td>5.52 (ND–13.9)</td>
<td>1.97</td>
<td>ND (5.69)</td>
</tr>
<tr>
<td>9,10-CIPhe</td>
<td>0.15</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>9-ClPhe</td>
<td>0.15</td>
<td>9.46 (10.00–21.5)</td>
<td>9.64 (40.46)</td>
<td>22.5 (ND–33.6)</td>
<td>2.24</td>
<td>ND (0.29)</td>
</tr>
<tr>
<td>6-ClAnt</td>
<td>0.13</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>6,12-ClChl</td>
<td>0.09</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND (0.93)</td>
</tr>
<tr>
<td>7,12-ClChl</td>
<td>0.13</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND (0.71)</td>
</tr>
<tr>
<td>6-ClCl</td>
<td>0.27</td>
<td>19.5 (0.84–25.2)</td>
<td>3.99 (ND–9.6)</td>
<td>43.3 (21.1–66.9)</td>
<td>16.0</td>
<td>ND (73.1)</td>
</tr>
<tr>
<td>≥CIPAHs</td>
<td>0.30</td>
<td>51.9 (32.3–101)</td>
<td>87.5 (49.0–511)</td>
<td>103 (37.2–139)</td>
<td>28.6</td>
<td>ND (96.4)</td>
</tr>
</tbody>
</table>


⁹ The limit of quantification (LOQ) for each CIPAH was set to be the lowest concentration of calibration standard. All concentrations calculated as ND = 0, <LOQ = 1/2LOQ.
Occupational concerns

• Workers have (much) higher exposures to hazards than communities
  • Workers *create* hazards for communities

• Common occupational exposures
  • Skin contact with heavy metals
  • Inhalation of air contaminants
  • Injury risk (cuts, struck-by)
  • Musculoskeletal issues
  • Burns
  • Noise
Occupational concerns

• Common exposures (continued)
  • Infectious agents
  • Heat stress
  • Food/water access
  • Food/water contamination
  • Inadequate sanitation
Community concerns: general

• General ecological degradation

• Air pollution

• Water pollution

• Soil/food contamination

More vehicular traffic
Community concerns: crops

• Crop production near informal e-waste recycling activities

• Contamination of agricultural products

• Harm to pollinators
Community concerns: livestock and wildlife

• Animals grazing/feeding near e-waste recycling activities

• Contamination of meat

• Sickened/dead animals
Community concerns: water bodies

• E-waste recycling activities often occur near ponds and rivers

• Contamination of edible fish

• Sickened/dead aquatic life
Community concerns: food preparation and storage

• Preparation of food on same surfaces where e-waste recycling activities occur

• Other potential contamination issues (e.g., pesticide and chemical storage)
Community concerns: children

- Families in close proximity to e-waste recycling

- Children may have worse exposures (behavior) and health outcomes (developmental stage)
Community concerns: access to services

- Many informal recyclers in poor health (though not necessarily due to e-waste)
- Access to physical/mental healthcare limited or entirely out of reach
- Illegal e-waste recycling activities further reduces access
So...what *don’t* we know?

• Lots of studies of human exposures, environmental contamination

• Fewer studies connecting these two types of information

• Relatively few studies on health outcomes

• Most studies focus on a few sites
Questions?

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