

Hazardous occupational and community exposures in informal e-waste recycling

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Economic considerations

Increasing benefit



Increasing population

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

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

* Income and wage figures are calculated using



“Typical” e-waste exposure study

TABLE 1. Limit of Quantification and Mean and Ranges of Concentrations^a (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

compound	LOQ	e-waste recycling facility					industrial complex		other locations
		electronic shredder waste n=5	leaf n=6	floor-dust n=5	soil n=10	urban soil (reference) n=3	soil n=12	rural soil (reference) n=2	agricultural soil n=7
9-ClFlu	0.12	ND	ND	ND	ND	ND	ND	ND	
9-ClPhe	0.09	ND	16.9 (3.67–28.1)	ND	0.49 (ND–2.76)	ND	ND	ND	
2-ClAnt	0.36	ND	ND	ND	ND	ND	ND	ND	
9-ClAnt	0.17	ND	ND	ND	0.05 (ND–0.53)	ND	ND	ND	
3,9-Cl ₂ Phe	0.20	0.94 (ND-1.65)	5.59 (2.86–9.82)	0.41 (ND–2.06)	0.15 (ND–1.53)	ND	0.37 (ND–4.49)	ND	
^b 9,10-Cl ₂ Ant/ 1,9-Cl ₂ Phe	0.21	ND	1.84 (0.75–2.64)	1.38 (ND–6.88)	0.09 (ND–0.51)	ND	ND	ND	
9,10-Cl ₂ Phe	0.06	ND	3.01 (1.58–5.09)	0.73 (ND-2.22)	ND	ND	0.13 (ND–0.56)	ND	
3-ClFlu	0.13	0.52 (0.46–0.65)	7.95 (1.24–16.5)	3.72 (2.44–5.91)	0.49 (ND–2.67)	ND	0.73 (ND–2.50)	0.05 (ND–<0.13)	
8-ClFlu	0.14	13.2 (8.23–20.4)	4.34 (1.27–7.80)	9.40 (1.31–15.6)	1.25 (ND–6.59)	ND	0.01 (ND–<0.14)	ND	
1-ClPyr	0.15	14.9 (7.48–26.7)	27.7 (15.8–44.8)	16.6 (6.86–31.8)	4.06 (ND–11.0)	ND	4.58 (ND–36.7)	ND	
3,9,10-Cl ₃ Phe	0.14	5.43 (4.19–6.39)	7.00 (3.73–11.7)	5.32 (ND–13.3)	1.87 (ND–5.69)	ND	0.20 (ND–2.45)	ND	
5,7-Cl ₂ Flu	0.17	ND	ND	ND	ND	ND	ND	ND	
3,8-Cl ₂ Flu	0.18	ND	ND	ND	ND	ND	ND	ND	
3,4-Cl ₂ Flu	0.18	ND	ND	ND	ND	ND	ND	ND	
6-ClChr	0.15	ND	ND	ND	ND	ND	ND	ND	
7-ClBaA	0.27	10.6 (4.00–21.3)	9.64 (ND-40.6)	22.5 (ND-33.8)	2.24 (ND-13.0)	ND	0.69 (ND-8.29)	ND	
6,12-Cl ₂ Chr	0.13	ND	ND	ND	0.09 (ND-0.85)	ND	0.38 (ND-2.48)	ND	
7,12-Cl ₂ BaA	0.13	ND	ND	ND	ND	ND	0.71 (ND-4.75)	ND	
6-ClBaP	0.27	13.5 (5.84–25.3)	3.59 (ND-6.96)	43.3 (21.1–66.9)	16.0 (ND-73.1)	ND	80.2 (6.73–231)	0.19 (ND-<0.27)	
ΣCIPAHs		59.1 (32.3–101)	87.5 (46.0–111)	103 (37.2–139)	26.8 (ND-96.4)	ND	88.0 (13.2–278)	0.19 (ND-0.38)	
								0.10 (ND-<0.27)	
								0.15 (ND-0.76)	

^a 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. ^b 9,10-Cl₂Ant and 1,9-Cl₂Phe coeluted in this study.



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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