Electronic Waste Management
International Conference on Occupational and Environmental Health
Organized by OISD and COEH(MAMC)
December: 13-14, 2013, New Delhi

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Definition

- Electrical and electronic equipment’ or ‘EEE’ means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and designed for use with a voltage rating not exceeding 1,000 Volt for alternating current and 1,500 Volt for direct current;

- “Waste electrical and electronic equipment’ or ‘WEEE’ means electrical or electronic equipment which is waste within the meaning of Article 1(a) of Directive 75/442/EEC, including all components, subassemblies and consumables which are part of the product at the time of discarding.

Movement of WEEE Across International Borders

Export of e-waste

Known and Suspected Routes of e-waste Dumping

There is currently no system for tracking legal or illegal (under international law) shipments of electronic waste, and therefore, there is no quantitative data on volumes or even all of the true destinations. Some e-waste is shipped on "waste equipment" only to end up as waste upon arrival. This map indicates information collected through investigations by organizations such as the Basel Action Network, Silicon Valley Toxics Coalition, Toxics Link India, SCOPE (in Pakistan), Greenpeace and others.

Source: Greenpeace, Basel Action Network
WEEE in South Asian Region

Posted by tinderboxdaily on June 13, 2012 in India Buzz
Characteristics of WEEE

- Fastest growing waste stream, almost 50 million tones produced globally.
- Only 15-20% recycled, rest goes directly into landfills and incinerators,
- In developing countries (DC) expected growth by up to 500% over the next decade,
- DCs even with preventive legislation are unable to stop dumping ground of WEEE from developed countries.

Substances Released During E-waste Recycling

- Original materials in WEEE,
- Auxiliary substances, used in recycling,
- By-products; transformation of primary constituents,
- Leachates from dumping activities,
- Particulate matter (coarse and fine particles) in dismantling,
- Fly and bottom ashes from burning activities
- Fumes from mercury amalgamate during burning activities,
- Wastewater from dismantling and shredding facilities’,
- Effluents from cyanide leaching, other leaching activities or mercury amalgamation.

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* Lanthanides

** Actinides
Bio-Accumulative Toxics

Polychlorinated biphenyl

Dioxin

Furan

2,3,7,8-Tetrachlorodibenzo-para-dioxin

Tetraethyl lead

Monomethyl mercury

Tributyl tin

Polycyclic aromatic hydrocarbon (benzo(a)pyrene is shown)
Brominated Flame Retardants (BFRs)

- Electronics industry greatest user.
- Waste recycling sites in developing countries are among the most significant sources of BFR releases to the environment.

*Source:* Harmful Substances and Hazardous Waste; *UNEP Year Book 2010*

- There are three broad classes of BFRs: tetrabromobisphenol-A (TBBPA), Hexabromocyclo-dodecane (HBCD), and Polybrominated diphenyl ethers (PBDEs).
- Concern is greatest about PBDEs, partly because they degrade slowly and are known to build up in air and soils in urban source regions.
Selenium
Exposure to high concentrations causes Seleniumosis, which can cause hair loss, nail brittleness, and neurological abnormalities like numbness and other odd sensations in the extremities.2

Beryllium
Exposure can cause lung cancer and chronic Beryllium disease. Symptoms of chronic beryllium disease include breathing difficulties, coughing, chest pain, and general weakness.3

Mercury
Exposure through ingestion or inhalation can cause central nervous system damage and kidney damage.4

Chromium (IV) - Hexavalent Chromium
Exposure can cause strong allergic reaction (linked to Asthmatic Bronchitis) and DNA damage to cells. Workers are exposed at disposal stage and Chromium (IV) can also be released into the environment from landfills and incineration.5

Arsenic
Long-term exposure may cause lung cancer, nerve damage and various skin diseases. Arsenic gas (AsH3), used in tech manufacturing, is the most toxic form of arsenic.6

Trichloroethylene (TCE)
Exposure to TCE (depending on amount and route) can cause liver and kidney damage, impaired immune system function, impaired fetal development, or death. Manufacturing workers and communities where TCE leaches into drinking water are at greatest risk.7

Cadmium
Long-term exposure to cadmium can cause kidney damage and damage to bone density. Cadmium is also a known carcinogen.

Lead
Lead exposure can cause brain damage, nervous system damage, blood disorders, kidney damage, and damage to fetal development. Children are especially vulnerable.

Polyvinyl chloride (PVC)
PVC is the most widely used plastic found in everyday electronics. When burned it produces large quantities of hydrogen chloride gas which combines with water to form hydrochloric acid (HCl). Inhaling HCl can cause respiratory problems. Production and incineration of PVC creates dioxins.8

Barium
Exposure may lead to brain swelling, muscle weakness, damage to heart, liver and spleen, or increased blood pressure.9

Brominated flame retardants (BFRs)
Suspected of hormonal interference (damage to growth and sexual development), and reproductive harm. BFRs are used to make materials more flame resistant. Exposure studies have shown BFRs in breast milk and blood of electronics workers, among others.10

Polychlorinated biphenyls (PCBs)
Toxic effects of PCBs include immune suppression, liver damage, cancer promotion, nervous damage, reproductive damage (both male and female), and behavioral changes. PCBs were widely used prior to 1980, and are still present in transformers and capacitors. Though banned in many countries, they are still present in plastics.11

Dioxins and Furans
Skin disorders, liver problems, impairment of the immune system, the endocrine system, and reproductive functions; effects on the developing nervous system and some types of cancers.
Exposure Pathways at Work

- **Inhalation most prevalent**
- **Dermal**
- **Ingestion**

- **Dismantling-Dust**
- **Acid treatment**
- **Burning of e-waste**
- **Contact with corrosives**
- **Inadvertent hand to mouth during work**
- **Eating, and drinking liquids in workplace**
Penetration of Chemicals through different body regions

- Scalp: 3.7
- Forehead: 4.2
- Ear canal: 5.4
- Abdomen: 2.1
- Forearm: 1.0
- Genital area: 1.8
- Palm: 1.3
- Ball of foot: 1.0
Para Occupational Exposure

- Visitors and bystanders,
- Family Members

- Inhalation of acid vapours and metal fumes,
- Hazardous Material Transfer to Home when workers do not change clothes, e.g. Lead particles and dust deposited on clothes
**WEEE- Environmental Impact in India**

- Cu, Zn, Ag, Cd, In, Sn, Sb, Hg, Pb, and Bi were higher in soil in recycling sites, exceeding screening values given by US, EPA,
- Air borne concentrations of Cr, Mn, Co, Cu, In, Sn, Sb, Tl, Pb Bi were higher at e-waste recycling facility compared with Chennai city,
- High levels of Cu, Mo, Ag, Cd, In, Sb, Tl, and Pb were observed in hair of male workers from e-waste recycling sites.

WEEE-Adverse Health Impact at Work

- Traumatic Injuries
- Eye Splashes
- Acute Chemical Pneumonitis and Pulmonary edema,
- PVC Dust
- Metal Fume fever
- Polymer Fume Fever
- Cuts, lacerations in dismantling,
- During Acid Treatment,
- Hg, & Cd
- PVC Pneumoconiosis
- Placing Metal Containing Zinc in corrosive acids,
- Burning plastics and smoking
- Fluoropolymer (Teflon) + Smoking
# WEEE - Dismantlers and Recyclers Comparison

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<th>Dismantlers</th>
<th>Recyclers</th>
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<td>Small Units within 3 - 4 workers each</td>
<td>Comparatively bigger units with 8 - 10 workers</td>
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<tr>
<td>Units individually owned and owner found at premises during working hours</td>
<td>Owners seldom visited the site</td>
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<tr>
<td>Dismantlers were comparatively younger and fewer women workers</td>
<td>Recyclers were aged and more women workers were found</td>
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<td>Relatively stable workforce</td>
<td>Rapid turnover of workforce</td>
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<td>Hazards identified:</td>
<td>Hazards identified:</td>
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<tr>
<td>• Dust: 72.7%</td>
<td>• Acid fumes: 64.7%</td>
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<tr>
<td>• Heat: 14.5%</td>
<td>• Smoke: 41.2%</td>
</tr>
<tr>
<td>• Smoke: 9.6%</td>
<td>• Dust: 38.2%</td>
</tr>
<tr>
<td>• Lifting heavy load: 9.2%</td>
<td>• Lifting heavy load: 21.4%</td>
</tr>
<tr>
<td>Dismantlers perceived DUST as the most important health hazards</td>
<td>Recyclers perceived acid fumes most troublesome</td>
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<tr>
<td>Poorly ventilated</td>
<td>Better ventilation</td>
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<td>Personal Protective Equipment not provided (Gloves, Respirator/mask, shoes, coat and goggles)</td>
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Source: A Jointly Conducted Study by "Centre for Occupational and Environmental Health and The Energy and Resources Institute, funded by GTZ, Germany" at Seelampur, Mandloi and Shastri Park areas of Delhi
Nature of Tasks undertaken by Dismantlers and Recyclers

**Primary Job of Dismantlers**
- Breaking: 44%
- Separation of parts: 43%
- Loading/Unloading: 13%

**Primary Job of Recyclers**
- Furnace related work: 62%
- Separation of parts: 37%
- Loading/Unloading: 1%

Source: A Jointly Conducted Study by “Centre for Occupational and Environmental Health and The Energy and Resources Institute, funded by GTZ, Germany“ at Seelampur, Mandloi and Shastri Park
Other Findings

- Blood lead levels were higher in recyclers than dismantlers.
- Mean value was more than 30 ug/dL in both recyclers and dismantlers.
- Mean copper value for dismantlers was 22.4 ug/day.
- Mean serum copper value was 86.4 ug/dL.
- Mean chromium levels in dismantlers were below the detection limit of 1 ug/L.

Source: A Jointly Conducted Study by "Centre for Occupational and Environmental Health and The Energy and Resources Institute, funded by GTZ, Germany" at Seelampur, Mandloi and Shastri Park areas of Delhi.
Mean urinary chromium levels in recyclers were found to be 8.8 ug/day

Mercury levels were raised in dismantlers compared to recyclers but were within reference range, highest value 8ug/L

Cadmium levels were below detection limits

Mean levels of copper recorded during personal monitoring were at least two fold higher a the recycling stations than at dismantling stations.

Source: A Jointly Conducted Study by "Centre for Occupational and Environmental Health and The Energy and Resources Institute, funded by GTZ, Germany“ at Seelampur, Mandloi and Shastri Park areas of Delhi
Study by "Centre for Occupational and Environmental Health and Environmental Health and The Energy and Resources Institute
Blood Lead Levels in Workers at e-waste Recycling Facility, Delhi

Ref Std: 20 ug/dL
Study by "Centre for Occupational and Environmental Health and The Energy and Resources Institute
Urinary Chromium levels in workers at e-waste Recycling Facility, New Delhi

![Graph showing chromium levels and age distribution. The graph indicates that chromium levels are above the reference standard of < 10 ug/L in a day for some individuals.](image-url)
Conclusion and Concerns for India

- WEEE is a significant threat to environment, workers’ health, and ecosystems,
- Need immediate focus on Environmental Health in India,
- OHS for workers in informal recycling sector may be set up at the earliest,
- Issue of Child labour and pregnant women working in such places need to be addressed,
- Health Surveys, Research, sharing of data on Health and Environmental Impact of WEEE recycling may be encouraged.

*BMJ VOLUME 328 3 APRIL 2004 bmj.com; 787.*
*Environmental Health Perspectives. Volume; 111, No. 10. 2003; 1340-1347.*
Thanks