Occupational Risks Associated with Electronics Demanufacturing and CRT Glass Processing Operations and the Impact of Mitigation Activities on Employee Safety and Health

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Co-founder and CEO
Presentation Overview

- Description of Cascade and its industry
- Testing Goals: Testing Procedures
  - Mitigation program
- Results
- Future Research
- Resources for Recyclers
Industry Context

- Focus on US demanufacturers and processors
- Examine the working conditions of a typical small-scale demanufacturer or processor (50,000 - 400,000 lbs./month)
- Little capabilities for environmental monitoring programs
Industry Context

Distribution of Electronics “Recyclers” in the USA - 2002

Count of Firms

Number of employees in firm
Profile of Cascade

- Madison, Wisconsin base
- Established 1999
- January, 2003: 75 tpm - 14 employees
- April, 2003: 175 tpm - 21 employees
- 93% from business and institutions
- 57% of equipment demanufactured
- Separate CRT glass cutting operation
Testing, Data Scrubbing, Parts Harvesting, Reuse Markets
Manual Disassembly

- Recover reusable components
- Remove hazardous materials
- Generate clean commodities for market (~25 grades)
Shredding Activities

Plastic Size Reduction - also use vertical baler

Electronic Media Destruction
CRT Processing

Intact CRTs are pulled at demanufacturing facility and sent to CRT processing
CRT Processing

CRTs are prepped by cleaning contamination - removing implosion band
CRT Processing

Color CRTs are cut to separate panel glass from funnel/frit
Testing Goals

- Develop baseline of worker exposure to occupational health hazards
- Demonstrate compliance (or become compliant) with OSHA standards
- Test impacts of mitigation activities on occupational health
Minimum Standards

- Lead
  - EPA (waste) TCLP: 5.0 mg/L
  - OSHA (air) PEL: 50 µg/m³ over 8 hours
  - HUD (dust) 250 µg/f² on interior window sills

- Cadmium
  - EPA, TCLP: 1.0 mg/L
  - OSHA, PEL: 5 µg/m³ over 8 hours
Air & Wipe Survey Methods

- CRT Processing comparison study
  - Baseline conducted in 2001 at Milwaukee facility
  - Implemented mitigation activities
  - Follow-up in 2003 at Madison facility
- Air study measuring lead and cadmium
- Wipe samples throughout facilities
Mitigation Activities - CRT Processing

- Clean all spills using wet methods before spills dry
- Implement regular wet cleaning of all workstations (4 x day)
- Increase worker hygiene
  - no eating/drinking at workstations
  - wash hands and face before breaks
  - wear protective clothing
# Air Survey Results

CRT Area Sampling Results for **Lead**

<table>
<thead>
<tr>
<th>Monitoring Device Location</th>
<th>4-26-01</th>
<th>1-23-03</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT Operator</td>
<td>4.3</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Ambient air sample 1</td>
<td>0.42</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Ambient air sample 2</td>
<td>0.14</td>
<td>N/A</td>
</tr>
<tr>
<td>OSHA PEL</td>
<td>50.0</td>
<td>50.0</td>
</tr>
</tbody>
</table>

*Data listed in micrograms of contaminant per cubic meter of air (µg/m³) over an 8-hour time weighted period.*
## CRT Area Sampling Results for Cadmium

<table>
<thead>
<tr>
<th>Monitoring Device Location</th>
<th>4-26-01</th>
<th>1-23-03</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT Operator</td>
<td>&lt;0.1</td>
<td>0.75</td>
</tr>
<tr>
<td>Ambient air sample 1</td>
<td>&lt;0.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Ambient air sample 2</td>
<td>&lt;0.1</td>
<td>N/A</td>
</tr>
<tr>
<td>OSHA PEL</td>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Data listed in micrograms of contaminant per cubic meter of air (µg/m³) over an 8-hour time weighted period.
# Wipe Sample Results

Surface **Lead** Concentrations in CRT Processing Areas

<table>
<thead>
<tr>
<th>Wipe Sample Location</th>
<th>7-17-01</th>
<th>1-23-03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor behind CRT cutter</td>
<td>1510</td>
<td>430</td>
</tr>
<tr>
<td>Work table near CRT cutter</td>
<td>107</td>
<td>34</td>
</tr>
<tr>
<td>CRT prep table</td>
<td>1520</td>
<td>1100</td>
</tr>
<tr>
<td>Central tracking area</td>
<td>252</td>
<td>98</td>
</tr>
<tr>
<td>Break room/wash room</td>
<td>6</td>
<td>31</td>
</tr>
<tr>
<td>HUD hazard level on sills</td>
<td>250</td>
<td>250</td>
</tr>
</tbody>
</table>

*Data listed in micrograms of contaminant per square foot (µg/f²)*
## Wipe Sample Results

Surface **Cadmium** Concentrations in CRT Processing Areas

<table>
<thead>
<tr>
<th>Wipe Sample Location</th>
<th>7-17-01</th>
<th>1-23-03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor behind CRT cutter</td>
<td>37.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Work table near CRT cutter</td>
<td>7.7</td>
<td>1.2</td>
</tr>
<tr>
<td>CRT prep table</td>
<td>3.7</td>
<td>54.0</td>
</tr>
<tr>
<td>Central tracking area</td>
<td>15.0</td>
<td>27.0</td>
</tr>
<tr>
<td>Break room/wash room</td>
<td>&lt;=0.6</td>
<td>12.0</td>
</tr>
</tbody>
</table>

*Data listed in micrograms of contaminant per square foot (µg/f²)*
Possible Explanations

- Overall, exposure levels decreased due to hygiene programs.
- Increase in cadmium exposure at prep table likely due to an increased number of color CRTs broken by hand in 2003 - phosphor powder not wet.
- Increase in exposure at break room due to distances from processing area at locations.
Other Studies

- Demanufacturing area - shredding line
  - Total particulate matter in air - 8 hours
    - Measured amount: Max reading - 322 µ/m$^3$
    - OSHA PEL: 15,000 µ/m$^3$
  - Noise levels and exposure
    - Shredder operator: 83.4 dBA (8-hour reading)
    - OSHA PEL: 90.0 dBA - Action Limit: 85.0 dBA
Further Study

- Lead and cadmium exposure at facilities employing manual breakage of CRT glass without containment
- Concentration of flame retardants in particulate matter from shredders
- Presence of VOCs from baling plastics
- Noise studies at mechanized facilities
Recycler Resources

- OSHA Consultation Program
  - designed for small- and medium-sized business (up to 250 employees at a site)
  - Completely separate from OSHA enforcement
  - Provides assessments, testing, written recommendations, training materials
  - is free
Acknowledgements

- John Katers, UW-Green Bay
- Jim Barry, OSHA Consultation Program
Recycler Resources

- OSHA Consultation Program:
  – administered through states:

  www.osha.gov/oshdir/consult.html

- Cascade Asset Management studies

  www.cascade-assets.com