Thermal Waste Treatment - a Necessary Element for Sustainable Waste Management

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Goals and Principles of Waste Management

• Goals
  – protection of men and environment
  – conservation of resources
  – after-care-free landfills (precautionary principle)

• Principles
  – prevention
  – recycling
  – disposal
Growth of material flows

- **Paper**
  - Graph showing growth from 1960 to 1998.
  - Y-axis: [0, 2, 4] in [t/y]

- **Plastics**
  - Graph showing growth from 1960 to 1992.
  - Y-axis: [0, 2] in [t/y]

- **Lead**
  - Graph showing growth from 1980 to 1998.
  - Y-axis: [10^6, 10^7] in [M]

Plastic flows in Austria

- **Raw Material**: 1,100 [t/y 1994]
- **Primary Processing**
  - Stock: 40 [kt]
  - Duro- and polymers: 850 [t/y]
- **Product Manufacturing**
  - Stock: 90 [kt]
  - Stock: 360 [kt]
- **Consumption**
  - Stock: 7100+400 [t]
  - Stock: 491+62 [t]
  - Off gas: 26 [t]
- **Collection, Transporting, Sorting**
  - Stock: 9700+598 [t]
  - Stock: 46 [t]
  - Recyclate: 0 [t]
- **Energy Recovery**
  - Stock: 100 [t]
  - Stock: 0 [t]
- **Off Gas**
  - Stock: 50 [t]

Source: R. Fehringer, 1996
**Composition of Combustible Wastes in Austria**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Cl</th>
<th>Cd</th>
<th>Hg</th>
<th>Pb</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum conc.</strong></td>
<td>200</td>
<td>10</td>
<td>0.01</td>
<td>0.001</td>
<td>&lt;1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Maximum conc.</strong></td>
<td>670,000</td>
<td>480,000</td>
<td>500</td>
<td>10</td>
<td>4,000</td>
<td>16,000</td>
</tr>
<tr>
<td><strong>Average of all wastes</strong></td>
<td>9,100</td>
<td>4,300</td>
<td>5.7</td>
<td>0.8</td>
<td>230</td>
<td>520</td>
</tr>
<tr>
<td><strong>MSW</strong></td>
<td>7,000</td>
<td>8,700</td>
<td>10</td>
<td>2</td>
<td>800</td>
<td>1,100</td>
</tr>
</tbody>
</table>

**Relative Flow of Materials and Energy in Combustible Wastes in Austria**

![Relative Flow of Materials and Energy in Combustible Wastes in Austria](image)
Occurrence of Lead in waste materials

- MSW
- wood from construction and demolition
- construction wastes
- bulky wastes
- PVC-wastes
- others

Graph showing Pb-load [t/a] vs. 9.7 Mio. t/a combustible waste.

Occurrence of Chlorine in waste materials

- MSW
- PVC-wastes
- construction wastes
- residues from the production of oil and fat
- paper wastes
- others

Graph showing Cl-load [t/a] vs. 9.7 Mio. t/a combustible waste.
Waste Incineration means Pollution Control

- Flue Gas
- Waste Water
- Filter Cake
- Boiler Ash
- ESP-Ash
- Metal Scrap
- Bottom Ash
- MSW
- H2O
- Fresh Water
- Alkaline Process Water
- Acidic Process Water
- Measurement of Mass Flows [kg/h] or [m³/h]
- Measurement of Mass Flows and Concentrations [mg/kg]

Reduction of MSW incineration emissions from 1930 to 1995

- NOx
- SOx
- HCl
- Hg
- dioxins
- Cd
- Pb
- dust

change since 1930 in %

100
90
80
70
60
50
40
30
20
10
0

1930 1970 1995

emissions

Ecology and Eco-Technologies, February 24-28, 2002
Paul H. Brunner
Reduction of MSW incineration emissions from 1930 to 1995

<table>
<thead>
<tr>
<th>Emission</th>
<th>1930 (100%)</th>
<th>1970</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>SOx</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>HCl</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Hg</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Dioxins</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cd</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Pb</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Dust</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Contribution of MSW incineration to SO2 emissions in Austria

<table>
<thead>
<tr>
<th>Year</th>
<th>MSW incineration</th>
<th>Industry</th>
<th>Refinery</th>
<th>District Heating Plant</th>
<th>Caloric Power Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>20000</td>
<td>5000</td>
<td>1000</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>1991</td>
<td>20000</td>
<td>5000</td>
<td>1000</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>1992</td>
<td>20000</td>
<td>5000</td>
<td>1000</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>1993</td>
<td>20000</td>
<td>5000</td>
<td>1000</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>1994</td>
<td>20000</td>
<td>5000</td>
<td>1000</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>1995</td>
<td>20000</td>
<td>5000</td>
<td>1000</td>
<td>500</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: UBA-Info 1/97
### Fraction of Dioxins from MSW incineration in A and D

<table>
<thead>
<tr>
<th>Total emissions of PCDD/PCDF</th>
<th>Contribution of MSW Inc. *)</th>
<th>PCDD/PCDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>[g TEq/a]</td>
<td>[g TEq/a]</td>
<td>[%]</td>
</tr>
<tr>
<td>BRD ***)</td>
<td>800-1200</td>
<td>5,5</td>
</tr>
<tr>
<td>Austria ***)</td>
<td>50-320</td>
<td>0,53</td>
</tr>
</tbody>
</table>

*) ...... Assuming all waste is incinerated  
***) ...... Orthofer, R.; Vesely, A., 1990  
***) ...... Wintermeyer, D.; Rotard, W., 1994

### Comparison of emissions from MSW incineration and from household burning of refuse

<table>
<thead>
<tr>
<th></th>
<th>dust</th>
<th>HCl</th>
<th>SO₂</th>
<th>NO₂</th>
<th>CO</th>
<th>Hg</th>
<th>dioxins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g/t</td>
<td>g/t</td>
<td>g/t</td>
<td>g/t</td>
<td>g/t</td>
<td>g/t</td>
<td>µg TE/t</td>
</tr>
<tr>
<td>household</td>
<td>30.000</td>
<td>5.300</td>
<td>1.000</td>
<td>2.000</td>
<td>60.000</td>
<td>1</td>
<td>3.200</td>
</tr>
<tr>
<td>MSW incineration</td>
<td>40</td>
<td>40</td>
<td>150</td>
<td>400</td>
<td>200</td>
<td>0,3</td>
<td>3</td>
</tr>
</tbody>
</table>
Mass and Element Partitioning during MSW Incineration

Cd Recycling by MSW Incineration
Goals for MSW Incineration

- desinfection
- volume reduction
- energy recovery
- environmental protection
- complete mineralisation
- immobilisation
- concentration
- materials recycling