Why do we Need a New Knowledge Base for Goal Oriented Waste Management?

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What is a “knowledge base” for goal oriented waste management?

”information necessary to set up a waste management system”

1. wastes
   – mass flow, composition, speciation, properties …

2. waste treatment processes
   – transfer coefficients, energy demand, economic data …

3. waste management systems
   – goals and hierarchies
   – resources management
   – environmental management
Goal oriented waste management

1. Protection of men and environment
2. Conservation of resources
3. Sustainability: solve waste problems here and now → no aftercare

Knowledge base must:
- be tailored to ensure that waste management can reach these goals
- supply information for the design, operation and control of waste management systems on both micro- and macroeconomic level
Why do we need a new knowledge base – level of wastes

*Increasing complexity of products and waste composition (expl. IT products)*

15 Elements

60 Elements

11 Elements

Source: T. McManus, Intel Corp., 2006
(Courtesy T. Graedel)
Why do we need a new knowledge base – level of processes

*from low-tech to high-tech waste treatment requires more information*

- volume
- mass
- water content
- hazards
- mass
- energy content
- C, biogenic H, N, Hg, Cd, Cl, PCBs, etc.
- mass, density, volume
- C, Cl,
- polyethylene, PVC
- Fe, Cu, Sb, Cd, Pb, etc.
Increasing environmental constraints, expl. incineration

- Energy content, "particle size"
- + Lol, WC, C, Fe, fly ash/bottom ash properties
- + $C_{\text{biogenic}}$, H, N, Cl, S, N, Hg, dioxins, ... nanoparticles?

1896 1970 1990
Process information, necessary part of knowledge base (expl. Incineration)

- ~20% flue gas
- 70% filter ash%
- 10% bottom ash

- <0.02% flue gas
- 92% filter ash
- <1% waste water
- <1% filter cake
- 8-2% bottom ash

1970

Transfer coefficients

<table>
<thead>
<tr>
<th></th>
<th>Bottom ash</th>
<th>Filter ash</th>
<th>Flue gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.08</td>
<td>0.92</td>
<td>0.0002</td>
</tr>
<tr>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Time series for better waste management

*Monthly mean values of Cl and Cd in MSW determined from products of incineration*

Source: Morf et al. 2003; Morf et al. 2004
Selecting parameters for waste characterisation, (expl. MSW incineration)

substance flows in MSW as a fraction of total import

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Better decisions by expanding knowledge base (expl. paper in Austria)


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Better decisions by expanding knowledge base (ex. plastic wastes)

Source: R. Fehringer, 1998

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Better decisions by expanding information base (ex. plastic additives)

<table>
<thead>
<tr>
<th>Additives in plastics</th>
<th>Total consumption</th>
<th>Total stock</th>
<th>Packaging material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in kt/yr</td>
<td>in kt</td>
<td>in kt/yr</td>
</tr>
<tr>
<td>Plastics</td>
<td>1,100</td>
<td>7,100</td>
<td>200</td>
</tr>
<tr>
<td>Softeners</td>
<td>14</td>
<td>140</td>
<td>0.2</td>
</tr>
<tr>
<td>Ba/Cd- stabilizers</td>
<td>0.27</td>
<td>2.6</td>
<td>0.0002</td>
</tr>
<tr>
<td>Pb-stabilizers</td>
<td>1.8</td>
<td>18</td>
<td>0.002</td>
</tr>
<tr>
<td>Fire retardants</td>
<td>2.3</td>
<td>22</td>
<td>0</td>
</tr>
</tbody>
</table>

* % of total consumption
Knowledge base must include process information (expl. plastic recycling)
Knowledge base allows informed decisions (expl. plastic wm)

Plastic waste recycling

To reuse 73 %
Waste I 14%
Waste II 2%
Rest fraction 10%

Plastic waste incineration (MSW)

Fluegas <1 %
flyash 92 %
Waste water <1 %
Filter cake <1 %
Bottom ash 8 %

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Economic data necessary for wm knowledge base (expl. lead)

Source: Lohm et al., 1998
Conclusion: Elements of a wm knowledge base

• standard definitions of:
  - waste categories -> operational character of waste definition!
  - treatment processes, wm systems (incl. systems boundary)

• data sets (including uncertainty!) on wastes, processes and wm systems:
  - mass flows and waste properties
  - substance concentrations and flows, chemical speciation
  - time series
  - geographic data
  - resource data
  - environmental data

• economic data:
  - collection and treatment processes
  - wm and resource systems

• implementation:
  - ownership, management, transparency, availability
Thank you