The search for a final sink – key issue for environmental management

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Content

- Large flows and stocks
- Fate of flows and stocks?
- Examples of copper and NP
- Conclusions: Make "sinks" an issue,
  particularly for design and disposal
The last 100 years: unprecedented growth

1912
Meiringen: where Martin began …

2012
Asia: … where his career will end?
The growth of material turnover …

England 1840

China 2010
... asks for adequate sinks at the back end... and early recognition of overloading...
Global growth in metal production

source: Brunner & Rechberger 2004
Where have all the metals gone?

zinc

copper
Looking for copper …
Copper sources and sinks for ballast

System boundary “Bahnstreckenabschnitt (5.9 x 1,000 m, 1 year)”

Stocks [kg]
Flows [kg/km year]
Limits to recycling and disposal

**Quality criteria:**

- Landfill ordinance
- Recycling material
- Anthropogenic Cu
- Geogenic Cu

**Graph:**
- X-axis: Time [y]
- Y-axis: Cu in ballast recycling residue [mg/kg]

- Total Cu in ballast residue
Changes in copper stocks

~ 75 % of Cu flow uncontrolled into the environment
Sinks are required for all off-flows!

- corrosion and weathering
- offgas from consumption (CO₂ et al.)
- sewage
- recycling
- solid wastes

12/15
50% of NPnEO end up as NP in the environment

Needed: Product design in view of final sinks

System boundary

Nonylphenol [g/c-y] (figures in italic stand for NPnEO)
Nonylphenolpolyethoxylates NPnEO: n = 5 - 20
Nonylphenol NP: n = 0

Agricultural soil
+3 (30 mg/m²y)
Sinks and final sinks

ANTHROPOGENIC SINK

Inappropriate sinks
- use phase
- waste
- recycling

Appropriate sinks
- collection & recycling
- residue
- landfill
- waste treatment
- underground fill

ENVIRONMENTAL SINK

- resources
- emissions

ENVIRONMENT
- air
- soil
- water
Conclusions

- Economic activities require sinks
- Overloading of sinks has been observed for some substances
- The loading of sinks should be monitored -> early recognition
- Waste management has a key role in sink management:
  -> *transformation and final storage*

- Research needs:
  - Sinks – the ultimate resource?
  - Terminology and methodology: sinks, final sinks, appropriate sinks, and sink capacity
  - Linking resources with appropriate final sinks
  - Product design should include sink issues
  - Governance (REACH)?
Thank you

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Stocks of today are tomorrows wastes and resources

Input:
- long residence time materials

Output:
- wastes

- waste today: ~ 5 t/c.y
- waste in 36 years: ~ 15 t/c.y

mean residence time of 36 years
(= Martin at Stanford)
A “sink” is defined as a process that receives and stores or transforms anthropogenic material flows that have no positive value for mankind.

Examples
- water -> lakes/oceans -> sediments
- atmosphere
- pedo- & lithosphere

Transformations as sinks for organic substances:
- biogeogenic transformations (e.g. mineralization)
- anthropogenic transformations (e.g. thermal, biochemical)

A “final sink” is a sink that either destroys a substance completely, or that holds a substance for a very long time period.