Sewage sludge – resource or waste?

Phosphorus-recycling potential of sewage sludge and the impact of its treatment on environment and resource conservation

Jakob LEDERER, Christian OTT, Jeannette KLONK, Helmut RECHBERGER
Institute for Water Quality, Resources, and Waste Management
Vienna University of Technology

ISWA Annual Congress – Hamburg – 17.11.2010

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

Overview

- Introduction
- Part 1: Phosphorus Flows in the EU 15
- Part 2: Assessment of Health, Environmental, and Resource Impacts of different Sludge Treatment Options

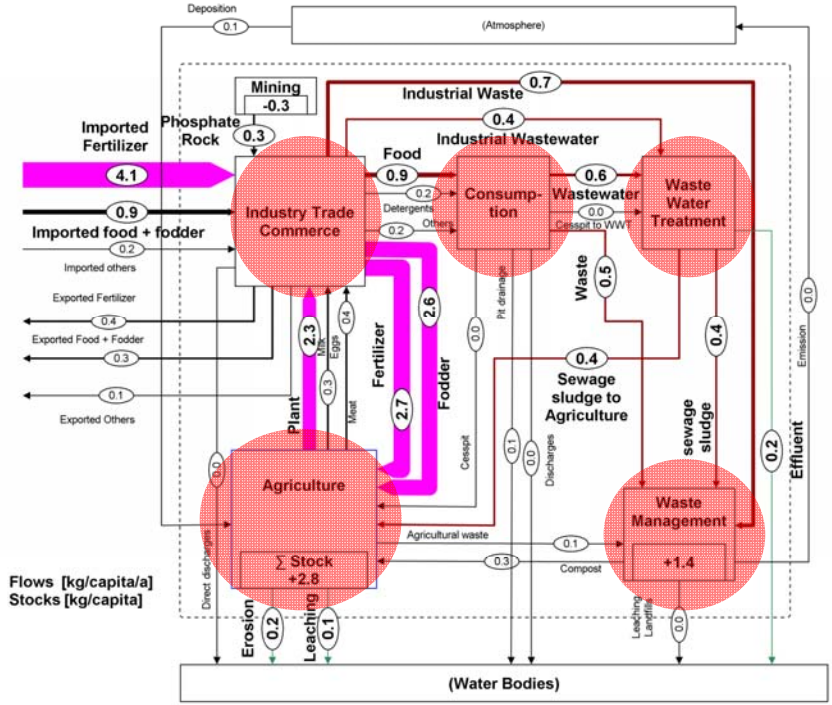
Part 1:
Phosphorus-flows of the EU 15

Organic P-flows from human activities „to nourish“ and „to clean“

Question: How much P is in the sewage sludge (if compared to other P-containing material flows)?

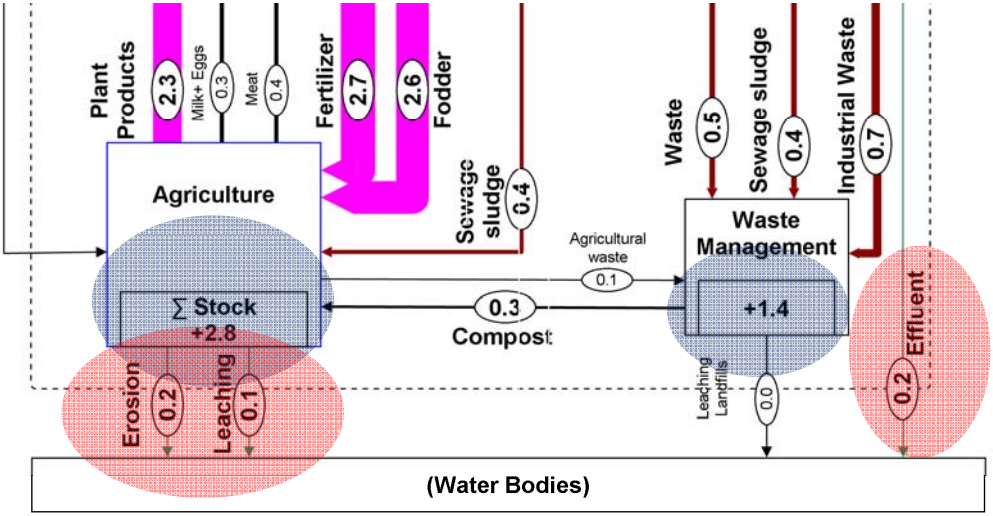
Based on:
OTT, C. and Rechberger, H. (in preparation)

Result: Phosphorus Flows in the EU15



Ott, C. and Rechberger, H. (in preparation)

Zoom on Phosphorus „Hot-spots“



Flows [kg/capita/a]
Stocks [kg/capita]

Conclusion Part 1

- Agriculture
  - Reduce emissions (eutrophication) and resource use
  - Higher efficiency without impairing productivity
- Waste management
  - 15% of mineral P fertilizer could be replaced if all generated sewage sludge is used
  - 55% of mineral P fertilizer could be replaced if all wastes in the „stock“ are used

Part 2:
Goal-oriented Comparative Assessment of Sewage Sludge Treatment and Disposal

Question: What are the impacts of different sewage sludge treatment options on human health, environment, and resources?

Based on:

Lederer, J. and Rechberger, H. (2010)

Comparative goal-oriented assessment of conventional and alternative sewage sludge treatment options

Sludge treatment options compared

1. Direct application of sludge on agricultural land	(Option 1 - direct soil)
2. Mono-incineration of sludge and ashes to soil	(Option 2 - mono-inc+soil)
3. Mono-incineration of sludge and ashes to landfill	(Option 3 - mono-inc+landfill)
4. Co-incineration of sludge in a cement kiln	(Option 4 - cement)
5. Co-incineration of sludge in a coal power plant	(Option 5 - coal)
6. SUSAN-technology	**(Option 6 - SUSAN)**

More details on the process engineering…

Final Program, p. 25/26

ORGANIC WASTE AND ENERGY RECOVERY II

Dominique Morau [France]
Optimization of the Anaerobic Digestion of Solid Waste by Addition of Leachate

Agnes Maier [Austria]
Mechanica-biological Treatment of Mixed Municipal Solid Waste: Experience in Austria and Portugal

Anke Boisch [Germany]
Recovery of Energy and Materials from Biogenic Household Waste collected in the City of Hamburg

Thomas Halbach, Stephanie Stuber [USA]
An Innovative Process for the Development of a Composting Facility in Ho Chi Minh City, Vietnam

URBAN MINING II

Miriam Fekkak [Germany]
Material Stocks and Flows in German Infrastructure Systems

Bastian Wens [Germany]
Environmental Impact of Metal Recycling – MSW as a Resource

Manfred Klinglmair [Austria]
Urban Mining in Times of Severe Raw Material Shortage: Copper Management in World War I Austria

Ulrich Kral [Austria]
Long-Term Management of Track Ballast – A Case Study in Prevention and Recycling of Big Waste Flows

NEW IDEAS FOR WASTE MANAGEMENT

Thorsten Schuetze [Netherlands]
Integrated Resource Management Concept for a Zero-emission Hotel in Berlin, Germany

Christian Adam [Germany]
Recycling of Waste Materials using Thermochemical Treatment

Baerbel Birnstengel, Jochen Hoffmeister [Germany]
Needed Immediately! An International Resource Management System

Hartmut Spliethoff [Germany]
Combining Energy from Waste and Concentrated Solar Power: New Solutions for Sustainable Energy Supply

HEALTH CARE WASTE

William King Townend [United Kingdom]
The Sustainable and Safe Management of Wastes from Healthcare Facilities

Jan-Gerd Kühling [Germany]
The Treatment of Healthcare Waste – Myths and Truth in the 21st Century

Ana Maria Moreira [Brazil]
Medical Waste Management Applied to a Small Capacity Health Unit in Brazil

SLUDGE TREATMENT

Günay Kocasoy [Turkey]
Comparison of Behavior of Sludge from Different Sources Co-disposed with Municipal Solid Waste

Jakob Lederer [Austria]
Phosphorus Recycling Potential of Environmental Impacts of Sewage Sludge Treatment in the EU 15

Benedikt Nowak [Austria]
Sewage Sludge Ash to Phosphate Fertilizer via Thermochemical Treatment

E-WASTE

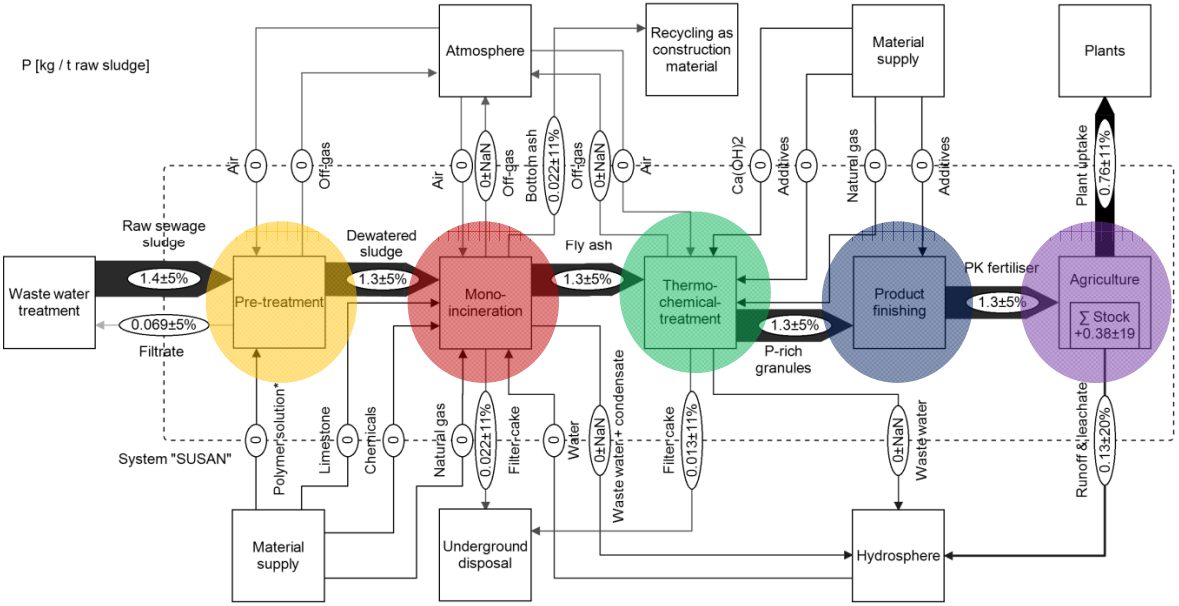
Lakshmi Raghupathy, Christine Krüger [Germany]
E-waste Recycling in India – Bridging the Gap between the Informal and Formal Sector

Ralf Bruening [Germany]
The VDI 2343 Guideline Provides Recommendations for the Concerned Parties – Part Reuse

Horst Broehl-Kerner [Germany]
Sustainable Reuse of Electric and Electronic Appliances

Phosphorus Recycling from Sewage Sludge

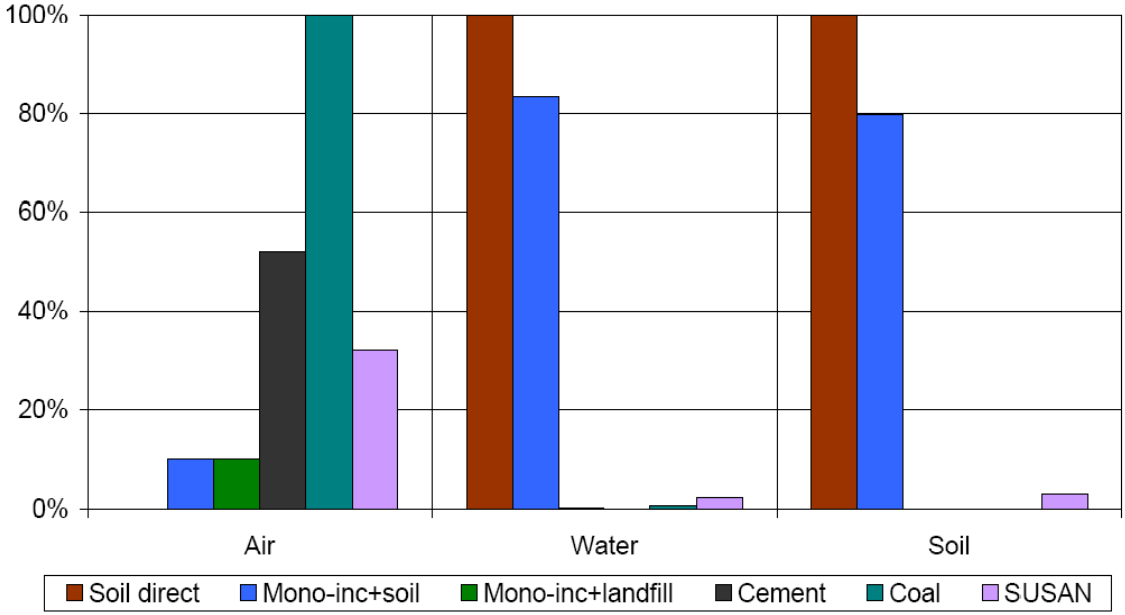
Example: MFA Phosphorus SUSAN



Goal-oriented Assessment Indicators

Indicator	Goal addressed
Heavy metal emissions to air Heavy metal emissions to water Heavy metal emissions to soil NO_X emissions to air Accumulation of heavy metals in soils	Protection of human health / environment
Primary energy balance Phosphorus recovery	Conservation of resources
Substance concentrating efficiency	both

Impacts through Air-Water-Soil Emissions



Summary of results

1. direct soil	+ energy balance; P-recycling - emissions to soil and water, dilution of substances
2. mono-inc+soil	+ emissions to air; P-recycling - emissions to soil and water, dilution of substances
3. mono-inc+landfill	+ emissions to air - P-recycling

Summary of results + Conclusion

4. cement	+	emissions to soil and water
	-	P-recycling; emissions to air
5. coal	+	emissions to soil and water
	-	P-recycling; energy balance
6. SUSAN	+	P-recycling, low emissions to soil and water, lowest dilution of substances
	+/-	energy balance, emissions to air

- **SUSAN represents a good compromise between the goals of waste management**
- **Improvement of energy consumption and off-gas cleaning during thermal treatment required**

Thank you!

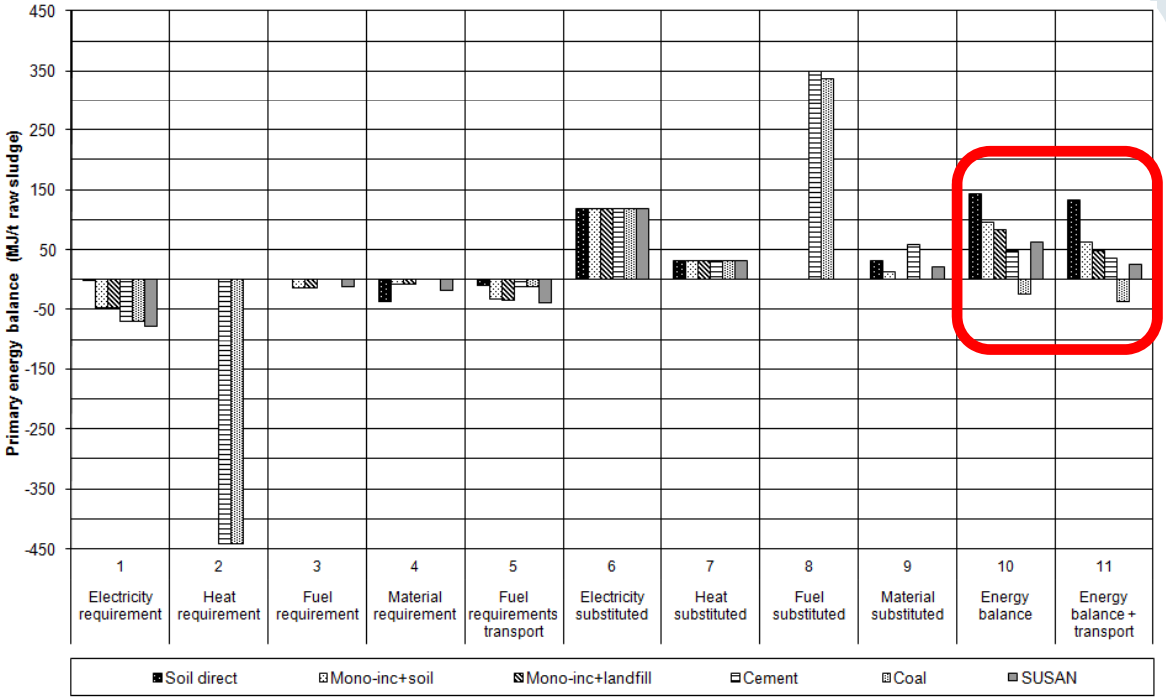
This project was funded through the European Union‘s 6th framework program.

STAN freeware for material flow analysis

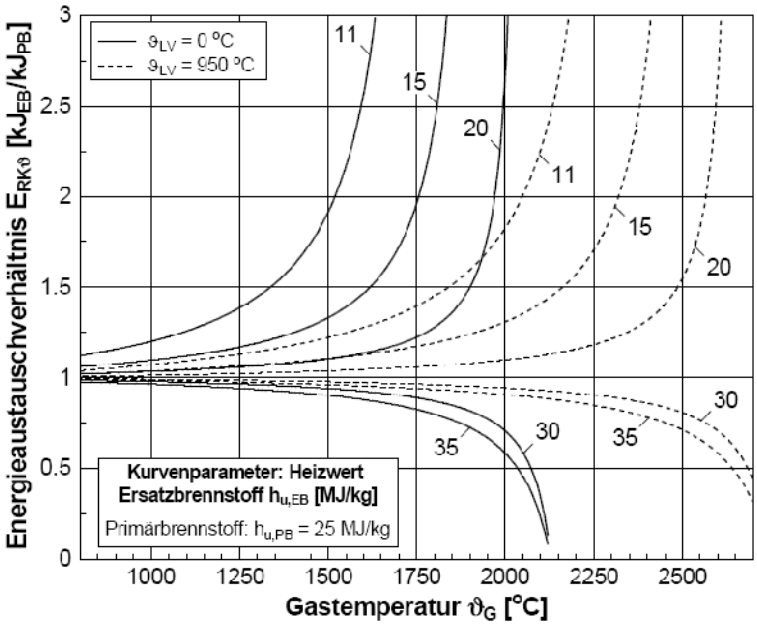
Download from our homepage

http://www.iwa.tuwien.ac.at/iwa226/stan.html

Energy Balance

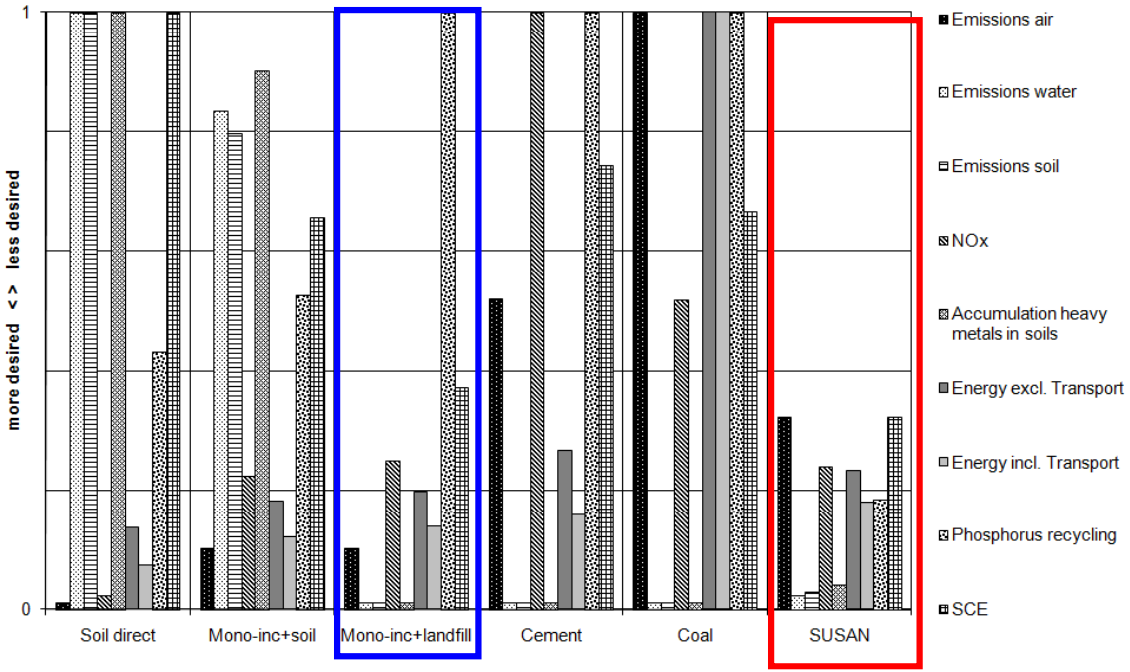


Energy Exchange Ratio

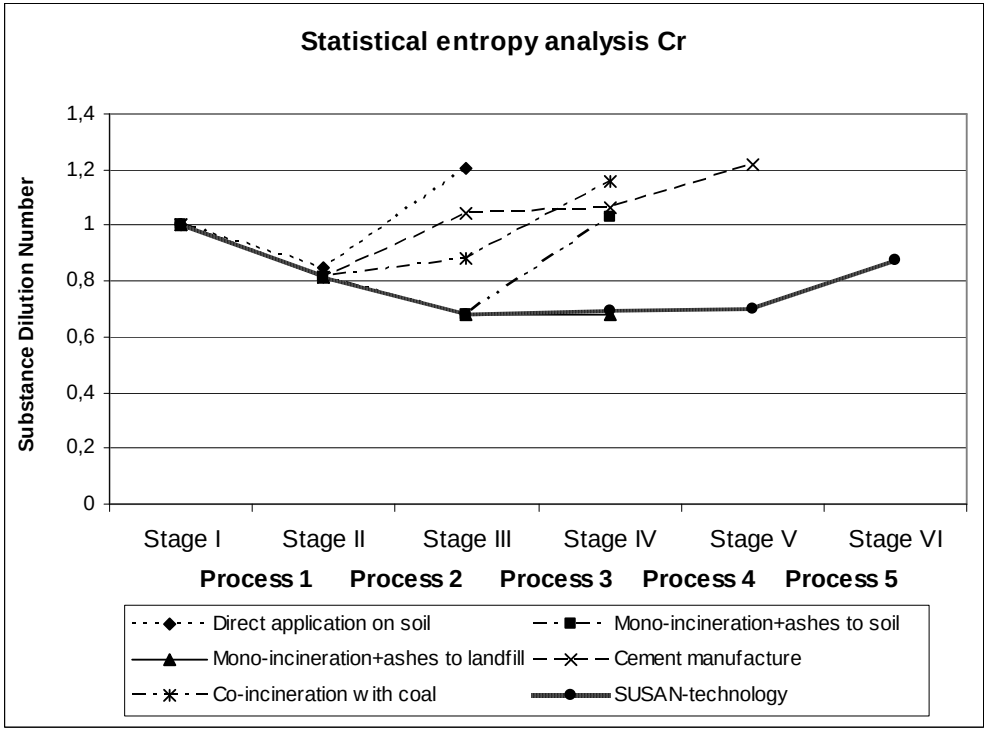


Beckmann et al. 2001 „Abfallbehandlung in thermischen Verfahren.“ In Bahadir, M., Collins, H.J., Hock, B. (Publisher). Teubner-Reihe Umwelt. Stuttgart/Leipzig/Wiesbaden.

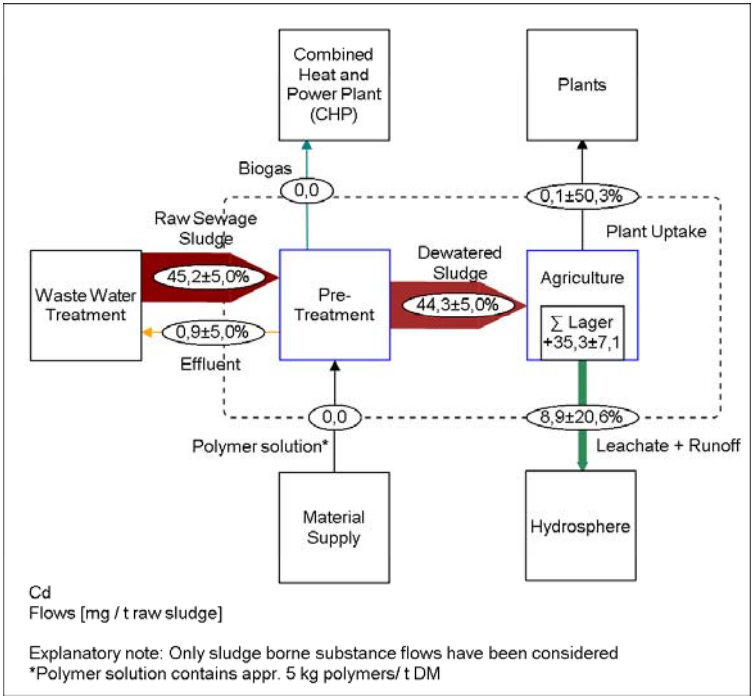
Cumulative Results



Example Dillution of Substances



Example Cd Flows Sludge Direct



Contaminants in Sludge

Heavy metal contents decline in some countries (e.g. Germany)…..

….. but „new“ compounds and substances increase.

- Impacts of these partially unknown
  - Nano-materials
  - Organic compounds
- Precautionary principle vs. Trial and error

Example Cd Flows SUSAN