Valorization strategies for wastewater treatment sludge


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Sludge’s origin

Urban residual sludges:
Activated sludge wastewater treatment plant (WWTP)

Oupeye, Belgium – 446500 PE
Waste Water Treatment Plant

Screening
Sand and grease removal

Settling
Chemical purification
Biological purification

SLUDGE
Sludge processes

### Conditionning
- Coagulation
- and Flocculation
- DS $\cong 1\% - 4\%$

### Mechanical Dewatering
- Band filter
- or Press filter
- or Centrifugation
- $\rightarrow 15\% - 40\%$

### Thermal Drying
- Convective dryer
- or Conductive dryer
- or Radiative dryer
- $\rightarrow 95\%$

### Valorization
- Agriculture
- or Energy
- or New technologies
Sludge processes

- **Conditioning**
- **Mechanical Dewatering**
  - Band filter
- **Thermal Drying**
  - Convective dryer
- **Valorization**
  - Agriculture
  - or Energy
  - or New technologies

**Phosphorus recovery**

- DS $\cong 1\% - 4\%$
- 15\% - 40\%
- 95\%
Quantities

Europe:
about 50 to 60 million tons of humid sludge

Global production:
More than 50 million tons of dry sludge

<table>
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<tr>
<th>Countries</th>
<th>Sludge Production Volume Tds/a</th>
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<tr>
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<td>2010 estimate</td>
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<td>2020 estimate</td>
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Ideal valorization

Lansink ladder + LCA method

- A. Reduce
- B. Reuse
- C. Recycle
- D. Compost
- E. Incinerate with energy recovery
- F. Incinerate
- G. Landfill

Eurostat 2013
Agriculture valorization

• Mineral and organic elements
  – Humic value
  – Fertilizer

• Process
  – Direct: liquid or dewatered sludge spreading
  – After composting
  – After drying
  – After biomethanation (→ + Energy!)
Energy valorization

- Incineration in a specific furnace
- Co-incineration with domestic waste
- Incineration in cement kilns
- Biomethanation
- Pyrolysis/gazification

\[ \Rightarrow \text{cogeneration} \]
Thermo-conversion

• Pyrolysis or gazification
• Energy + Production of new materials:
  – Syngas (CO, H\(_2\)) \rightarrow\) organic compounds
  – Adsorbants
• In progress

http://www.biogreen-energy.com/overview/processes/
High value products

- Sludge = raw material
- Microorganism vs classical process
- Products:
  - Biosorbants
  - Bioplastics
  - Bioflocculant
  - Biopesticide
  - Biofertilizer
  - Enzyme
  - ...
- Difficult scaling up
- VEOLIA → bioplastics (PHA) : AnoxKaldnes pilot

http://www.unil.ch/dbmv/page12541_en.html
Phosphorus recovery

- Critical raw material for the EU: 2014
- Phosphorus is a major element for Life
- 90% of fertilizers \(\Rightarrow\) Phosphate rock \(\Rightarrow\) resource depletion
Phosphorus recovery

WWTPs remove P to avoid P discharge in rivers

Sewage sludge containing P is removed

Avoid P-loss!

Consumer take up P in their food, release it in human excrements => P gets into waste water

Agriculture & food production need P

Reduce P-rock import into EU!

Lippeverband
Phos4You project

• 12 European partners in 7 states

• 6 demonstrators of technologies
  – Thermal treatment of sludge → EuPhoRe → P Slag
  – Ash leaching → TetraPhos → H₃PO₄
  – Sludge leaching → PULSe → CaP
  – Precipitation from liquor → STRUVIA → MAP/DCP
  – μ-Algae biomass
  – Sorbant material for P₂O₅

  \[ \text{Innovations for small WWTP} \]
Thank you for your attention!