Thermo-chemical sludge treatment and P-recovery
First results of the EUPHORE pilot plant
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EGLV
Catchment areas

Water course
- Pumping station
- Waste water treatment plant

<table>
<thead>
<tr>
<th>Catchment Area</th>
<th>Area (km²)</th>
<th>Inhabitants (Mill.)</th>
<th>Inhabitants/ km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lippeverband</td>
<td>3280</td>
<td>1.4</td>
<td>427</td>
</tr>
<tr>
<td>Emschergenossenschaft</td>
<td>865</td>
<td>2.4</td>
<td>2775</td>
</tr>
</tbody>
</table>
### MANDATORY P-RECOVERY IN GERMANY

... as defined by sewage sludge ordinance (AbfKlärV; 2017)

<table>
<thead>
<tr>
<th>Possible disposal pathway</th>
<th>wwt &gt; 100,000 PE from 2029 on</th>
<th>wwt &lt; 100,000 PE and &gt; 50,000 PE from 2032 on</th>
<th>Wwt &lt; 50,000 PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land application</td>
<td>Prohibited</td>
<td>Permitted acc. fertiliser regulations</td>
<td></td>
</tr>
<tr>
<td>Co-incineration</td>
<td>Only if P-content &lt; 20g/kg DM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mono-incineration with P-Recovery or SSA-disposal</td>
<td>If P-content &gt; 20g/kg DM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Including direct use of sewage sludge ashes as fertiliser / component
PROJECT PHOS4YOU

Demonstrating P-Recovery technologies (WP T1)

I1 Sludge / Thermal treatment
I2 Ash / Leaching
I3 Sludge / Leaching
I4 Small wwtp NBS (algae)
I5 Small wwtp / Innovation (adsorption)
I6 Sludge liquor / Downscale of struvite precipit.

Perspectives (WP LT)

P-Ash DCP CaP/MgP H$_3$PO$_4$ Struvite

Showcasing P-Recycling value chains (WP T2)

EUPHORE®-TECHNOLOGY

General information

- 2-stage thermo-chemical treatment of sewage sludge
- Drying, pyrolysis and incineration in a rotary kiln
- Using additives such as MgCl₂ and temperatures up to 1,100°C, heavy metals are transferred to the gas phase, thus ensuring heavy metal depletion of the ash
- Due to the thermo-chemical treatment, phosphates are plant available
- Since the ash can completely be used, only a small amount of waste to dispose of remains (flue gas ashes)
EUPHORE®-TECHNOLOGY

Schema

Sewage sludge (dewatered) + Additives

Energy / Gases

Incineration

Flue gas cleaning

Flue gas

Step 1: Drying

Step 2: Reduction
650-750°C

Step 3: Oxidation
900-1,000°C

Ash containing P
Basic material for fertiliser

Interreg
North-West Europe
Phos4You
European Regional Development Fund

EMSCHER
GENOSSENSCHAFT

EGLV.de
PILOT PLANT IN DINSKALKEN

Permission process

Permission process was coordinated / bundled by district council
First contact to authority incl. construction site visit already in 2016
Application according to water legislation (LWG)
Submission of application March / June 2018
Construction of pilot plant started summer 2018 (preliminary permission)
Final permission issued Jan / May 2019

Monitoring:
- Flue gas: “Full” analysis after commissioning; routine control measurements
- Input material: Analysis according to AbfKlärV
- Output material / ash: Regular analysis focusing on nutrients / P-availability and pollutants
Site: Dinslaken / Technikum of EGLV
Input: Sewage sludge; ca. 25 - 30 % DM
Capacity: approx. 100 kg sludge/h
Output: approx. 10 - 15 kg/h ash
PILOT PLANT IN DINSLAKEN
April 2019 – Plant is ready for operation

July – Employee event / public open day
PILOT PLANT IN DINSLAKEN
Experiences so far

- Operation of all components
- Matching of the components, optimisation of plant control etc.
- Operation of the whole chain conveyor belt – input lock – rotary kiln – ash production
- Continuous operation (2 days) incl. automated operation overnight
- Production of individual batches of ash
- Improvement of combustion and air system
# RESULTS

Lab-scale results: Heavy metal depletion

(mg/kg)

<table>
<thead>
<tr>
<th></th>
<th>No additives</th>
<th>3% MgCl₂</th>
<th>6% MgCl₂</th>
<th>Limit DüMV</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>12.6</td>
<td>5.36</td>
<td>2.74</td>
<td>40</td>
</tr>
<tr>
<td>Pb</td>
<td>149.0</td>
<td>27.8</td>
<td>22.7</td>
<td>150</td>
</tr>
<tr>
<td>Cd</td>
<td>2.6</td>
<td>0.52</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>Cr</td>
<td>152</td>
<td>138</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td>91.4</td>
<td>65.9</td>
<td>52.2</td>
<td>80</td>
</tr>
<tr>
<td>Hg</td>
<td>&lt; 0.05</td>
<td>&lt; 0.05</td>
<td>&lt; 0.05</td>
<td>1</td>
</tr>
<tr>
<td>Ti</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1</td>
<td>1</td>
</tr>
<tr>
<td>Cu</td>
<td>853</td>
<td>673</td>
<td>622</td>
<td>900</td>
</tr>
<tr>
<td>Zn</td>
<td>2220</td>
<td>940</td>
<td>547</td>
<td>5000</td>
</tr>
</tbody>
</table>

In compliance with limits of German fertiliser regulation

Factors:

- Properties of sewage sludge (Input)
- Type and quantity of additives
RESULTS
Lab-scale results: Fertilising effects
RESULTS
Lab-scale results: Fertilising effects

Development of plant mass (rye grass)

All 5 crops “a”

biomass yield comparable to “standard” P-fertiliser
OUTLOOK: USE OF ASH

Intended full-scale use of Phos4You-EuPhoRe-ashes (scale: 15-20 t/batch) as component of mixed fertilisers)
OUTLOOK: PLANT OPERATION

- Final optimisations completed
  - Drag chain conveyor (August/Sept. 2019)

- Start of routine operation (next weeks)
- Optimisation of operation + dosing of additives
- Routine analyses of sewage sludge and ash; monitoring of flue gas quality
- Assessment of the relationship between input- and output-quality

- Assessment of external sludges (Phos4You-partners)
CONCLUSION
Advantages of the technology

Drying, incineration and production of a fertiliser component in one step

Only a small amount of waste (flue gas ash)

Ash can directly be used as a fertiliser component
THANK YOU FOR YOUR ATTENTION