EuPhoRe-Process – Experiences and deployment’s Potential

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EuPhoRe-Process – Experiences and deployment’s Potential

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EuPhoRe-Process – Experiences and deployment’s Potential

1. The EuPhoRe technology

Dewatered Sewage sludge + Additives

Energy gas / flue gas

Step 1: Thermal reduction, incl. sludge drying
650 – 750 °C

Step 2: Thermal Oxidation
850 – 1.000 °C

Rotary kiln

Thermal post combustion

Flue gas cleaning

Flue gas 900°C, 6-8% O₂

Phosphate / P-fertiliser
2. The EuPhoRe pilot plant in Dinslaken

Dewatered sludge input

Combustor (process heat)

Chimney

Combustor (post combustion)

Flue gas cleaning (textile filter)

Adsorption agents (Ca(OH)$_2$)

Additives (MgCl$_2$)

Ash output

Rotary kiln
2. The EuPhoRe pilot plant in Dinslaken

Ready for startup in May 2019
3. Optimisations at the pilot plant (examples)

- Discharge system of the sludge storage
- Conveyor belt: gradient and speed
- Insulation of the rotary kiln
- Changing the burners
- Dosing system of the adsorbent material
- Adjustment of programming
- ...

All pictures: L. Pamuk / Emschergenossenschaft
### 4. Results: Heavy metals in the sewage sludge ash (SSA)

<table>
<thead>
<tr>
<th>Heavy metals</th>
<th>SSA 3% (March 2021)</th>
<th>SSA 6% (April 2021)</th>
<th>Limit (German Fertiliser Ordinance DüMV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>10</td>
<td>9,3</td>
<td>40</td>
</tr>
<tr>
<td>Pb</td>
<td>34</td>
<td>15</td>
<td>150</td>
</tr>
<tr>
<td>Cd</td>
<td>&lt;0,4</td>
<td>&lt;0,4</td>
<td>1,5</td>
</tr>
<tr>
<td>Cu</td>
<td>940</td>
<td>780</td>
<td>900</td>
</tr>
<tr>
<td>Ni</td>
<td>89</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>Zn</td>
<td>2100</td>
<td>1400</td>
<td>4000</td>
</tr>
<tr>
<td>Hg</td>
<td>&lt;0,05</td>
<td>&lt;0,05</td>
<td>1</td>
</tr>
<tr>
<td>Tl</td>
<td>&lt;0,4</td>
<td>&lt;0,4</td>
<td>1</td>
</tr>
</tbody>
</table>
4. Results: Pot trials

Harvest 5:
O-Control (above)
EGLV-ash 6% (below)

Source: HGoTech GmbH
4. Results: Grinding and granulation

Source: Eirich GmbH

Source: Lösche GmbH
5. Examples industrial scale: Oftringen and Mannheim

Oftringen:
- Thermo-chemical treatment for 30,000 t dewatered sewage sludge per year
- Dry Matter = 22-32%
- Commissioning 1992
- EuPhoRe-Process 2016

Mannheim:
- Thermo-chemical treatment for 135,000 t dewatered sewage sludge per year
- Dry Matter = 23-29%
- Expected commissioning 2022
6. Outlook and potentials

Autarkic plant for 85,500 t dewatered sludge per year
6. Outlook and potentials
Combination with waste to energy plant for 85,500 t dewatered sludge per year
7. Stand-alone or combination with waste incineration?

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autarkic Plant</td>
<td>+ Freely planning options on the free space</td>
<td>- Complete reinstallation of the flue and process gas line including cleaning</td>
</tr>
<tr>
<td></td>
<td>+ Shorter and simpler conveying routes possible</td>
<td>- no synergy effects can be used</td>
</tr>
<tr>
<td></td>
<td>+ Better logistics</td>
<td>- possibly more complex and expensive approval planning</td>
</tr>
<tr>
<td></td>
<td>+ Sufficient space required for future system expansions</td>
<td>- Significantly higher investment costs, since more equipment is required</td>
</tr>
<tr>
<td></td>
<td>+ Better control options with regard to temperature and O\textsubscript{2} content</td>
<td>- Significantly higher operating costs and more additional staff are required</td>
</tr>
</tbody>
</table>
## 7. Stand-alone or combination with waste incineration?

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combination waste to energy (wte)</td>
<td>+ Very simple system structure</td>
<td>- Complex planning of the system integration</td>
</tr>
<tr>
<td></td>
<td>+ Low investment and operating cost</td>
<td>- Impairment of the operation of the waste incineration lines due to the renovation work</td>
</tr>
<tr>
<td></td>
<td>+ Cost savings through shared use of the existing infrastructure and staff</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ Simplified approval planning</td>
<td>- slight reduction in the plant capacity for waste incineration, if the CO₂-neutral energy is not used</td>
</tr>
<tr>
<td></td>
<td>+ Entry of nitrogen and sulphate compounds reduces urea for flue gas cleaning and maintenance costs due to corrosion</td>
<td></td>
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</table>
8. Economic aspects

Scale-up study for 85.500 t/a dewatered sludge

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Autarkic Plant</th>
<th>Combination wte</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial investment</td>
<td>25,0 – 30,0 Mio. €</td>
<td>approx. -30 %</td>
</tr>
<tr>
<td>Opex</td>
<td>2,8 - 3,8 Mio. €/a</td>
<td>approx. -30 to -50 %</td>
</tr>
<tr>
<td>Finance costs</td>
<td>1,0 – 1,5 Mio. €/a</td>
<td>approx. -30 %</td>
</tr>
<tr>
<td>Treatment costs</td>
<td>50 - 53 €/t dewatered sludge</td>
<td>27 - 29 €/t dewatered sludge</td>
</tr>
</tbody>
</table>

SS: sewage sludge  
wte: waste to energy

Indicative pricing as per September 2021 and subject to volatility in raw material market pricings and changing financing costs
Thank you for your attention!