Swedish strategy for sustainable recovery of phosphorous

IVL Swedish Environmental Research Institute

Staffan Filipsson
Uwe Fortkamp
Östen Ekengren

staffan.filipsson@ivl.se
+46-727-27 93 12
Ownership - Independence

Owned jointly by the Swedish government and Swedish industry (50/50) through a foundation

50 years’ experience

In continuous development since 1966

Our 270 employees are our resource

- engineers, economists, social scientists, geoscientists, chemists, biologists, agriculturalists, communicators etc
- post-graduate studies and master’s degrees

Our locations

Stockholm – Gothenburg – Malmö – Beijing - Wuhan
Municipal WWTP of Today: A treatment facility

Challenges

- The water sector is a major energy user
- Greenhouse gas emissions
- Treated water is not used
- Outflows may contain pollutants, viruses, pathogens etc.
- Sludge seen as a problem
Tomorrow: A production facility in the circular economy

Opportunities:
- Waste as resource
- Net energy production
- Nutrients recovery/reuse
- Improved treatment
- Water reuse

Raw material (Waste water)

Nutrients

Energy

Production facility

Optimisation/less energy consumption

Water reuse

Sustainable production of energy and resources

Market opportunities
Swedish Water Innovation Center at Hammarby Sjöstadsverk
R3Water
“Innovations for water reuse, valuables recovery and resource efficiency”
Project objectives

- To support the transition from an urban wastewater treatment plant to a production unit of different valuables by demonstrating new solutions to address main challenges.

- To facilitate the market uptake of these innovative solutions.

Diagram:

- Reuse of water
- Recycling of valuables
- Resource efficient treatment

- Demo Spain
- Demo Sweden
- Demo Belgium

www.r3water.eu
R3Water technologies: Hydrothermal carbonisation (HTC)

Technical principle

**PROCESS**
- Converting of several wet biomasses, e.g. sewage sludge into coal
- Equal to the converting of carbon to fossil energy sources but only in 3 to 5 hours
- Simplified: Equal to the principle of a pressure cooker
- Predestined for phosphorous recycling

**PRODUCT**
- Biocoal, carbon dioxide-neutral
- Heating value 12 to 18 to MJ/Kg
- Sterile, easy-to-transport and store
pilot plant K3-335

full scale HTC-0
## Advantages with HTC

<table>
<thead>
<tr>
<th>Property</th>
<th>Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>efficient</td>
<td>&gt; 50% energy saving against thermal drying</td>
</tr>
<tr>
<td>hydrophobic</td>
<td>&gt; 70% dry matter across filter press</td>
</tr>
<tr>
<td>CE-value</td>
<td>&gt; 90% carbon-efficiency (CE-Wert)</td>
</tr>
<tr>
<td>flexible</td>
<td>every wet biomass with carbon content</td>
</tr>
<tr>
<td>economic</td>
<td>lower capital and operating expense (CAPEX, OPEX)</td>
</tr>
<tr>
<td>forward-looking</td>
<td>HTC has got a lot of advantages and is also suitable for phosphorous recovery</td>
</tr>
<tr>
<td>technology</td>
<td></td>
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</tbody>
</table>
Phosphates on HTC-coal are not intensive ligated as into ash from mono incineration plants.
It is only a kind of adhesion.
ADVANTAGE: AVA CLEANPHOS PROZESS

+ AVA cleanphos a smart technical work
+ A side benefit leached coal is better to dry than HTC-coal
+ High heating value increase by 1,0 to 1,5 MJ/kg
+ HTC-coal is porous and easy to activate

„Hydrothermal carbonisation combined with P-recycling and recovery provided as

AVA cleanphos technology

is a real alternative
to every treatment of sewage sludge“
Project managers and contact

- Uwe Fortkamp, uwe.fortkamp@ivl.se
- Klara Westling, klara.westling@ivl.se
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Swedish EPA Governmental Commission Report
In this presentation with focus on the sludge from WWTP

staffan.filipsson@ivl.se
+46 727 27 9312
osten.ekengren@ivl.se
+46 10 788 6543

ARREAU
EIP Water Action Group
Pooling resources – Innovating water
Background to the commission

Premises: A resource efficient phosphorous circle as far as possible free from toxic substances

Scope:
- Mapping of phosphorous resources
- The content of unwanted substances
- Focus on the agriculture, the food chain, on forestry industry, mine- and steel industry and on the Baltic sea

Evaluation of the potential for a sustainable recovery of P

Suggestions for stepwise introduction of stricter regulations and policies
The challenges for the commission

- Wide and complex area
- Based only on published data
- It was hard to find relevant data for the content of phosphorous and toxic substances
- The published results varies a lot within the same area

- Unsureness in the results of the report
- The areas with need for better knowledge are identified
The annual input to the agriculture and the food chain compared to out-put of phosphorous is 3 kg per hectare (!)
The use of sludge from WWTP

- Farmer land
- Construction material
- Coverage for deposits
- Forest
- Deposit
- Incineration
- Storage
- Other use
The content of lead in WWTP sludge 1981 - 2008
Future scenario (2030) for the use of sludge

<table>
<thead>
<tr>
<th>Usage</th>
<th>Ton/year (dry subst)</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer land</td>
<td>60 000</td>
<td>+20</td>
</tr>
<tr>
<td>Construction material</td>
<td>78 000</td>
<td>+20</td>
</tr>
<tr>
<td>Coverage of deposits</td>
<td>15 000</td>
<td>-60</td>
</tr>
<tr>
<td>Deposit</td>
<td>0</td>
<td>-100</td>
</tr>
<tr>
<td>Other usage</td>
<td>17 000</td>
<td>0</td>
</tr>
<tr>
<td>Storage</td>
<td>22 000</td>
<td>+26</td>
</tr>
<tr>
<td>Incineration</td>
<td>8 000</td>
<td>+226</td>
</tr>
</tbody>
</table>
The suggestions from the commission

The suggestions will push the development towards a more sustainable management of phosphorous:

- Reduced risk for spreading of infections
- Reduced risk for accumulation of metals and organic substances in soil
- Reduced leaching of nutrients
- Reduced risk for eutrophication
- Increased resource efficiency
- Reduced dependency of *pure* mineral fertilizers (decreased access to pure phosphorous in the future)
Results of the commission

- A great part of the metals and organic substances (e.g. pharmaceutical residues) found in the WWTP sludge is added through the human body.
- 250 organic substances identified (mainly residues of pharmaceuticals, pesticides and phthalates).
- Low effect of up-stream measurements, technical solutions for treatment of sludge needed.
- Substances that is phased out is decreasing, but those with increased usage also has increased conc. in sludge.
- The quality of the sludge still is improving but the easiest measurements are already carried out.
Results, cont.

- The use bio fertilizers produced from sludge for use in agriculture has a potential to increase
  - Dependent on the amount of digested food waste
  - The regulation and the demand for biogas are critical

- The cost for recovery of phosphorous throw incineration or struvite route is higher than the cost for mineral fertilizer.

- The combination of continues development of technologies and increased cost for mineral fertilizers could increase the demand for recovery of phosphorous
Suggestions for regulation

- Stricter regulation should lead to lower discharges of impurities to land
- The concentration of impurities should be that low that the risk for human health or the environment is eliminated
- Regulation for the maximum level of 8 metals and 5 organic substances in soil
- Regulation for hygienisation of all sludge from WWTP if put on any kind of land
- No regulation for hygienisation of bio-fertilizers or fertilizers from composts
Suggestions for regulation, cont.

- The amount of sludge from WWTP that can be put on land will decrease as the regulations get stricter.

- There is a need for finding usage of the sludge that does not meet the regulations for use on land.

- The probability that this sludge will be incinerated is high.
Suggestions for milestones until year 2018

- At least 40% of the phosphorous and 10% of the nitrogen should be recycled.
- Those fractions should be recycled to farmer land.
- No exposure to humans or the environment at levels that could be harmful.
- Manure from stables will be recycled to such extent that it balance the in-put versus the out-put from farmer land.
- At least 50% of food waste is treated biologically in such way that the nutrients will be reused.
- At least 40% is treated is such way that also the energy is recovered (now decided by the government).