Wastewater Treatment Update

FINLAND

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Wastewater Treatment in Finland

- 80% population is connected to municipal wastewater treatment plants
  - Treatment process is typically combined biological organic material and N removal + chemical precipitation of P
- 540 wastewater treatment plants (PE >50)
- Number of large WWTP is 10 (PE >100,000)
- Reduction level
  - BOD 97%
  - P 96%
  - N 56% (Helsinki 90%)
Methane Reduction, Recovery, and Use Initiatives in Finnish WWTP

- Municipal WWTP + digesters 18 pcs.
- Municipal sludge + biowaste combined digesters 8 pcs.
- Industrial WWTP 4 pcs.
Biogas production

- Biogas production at 60% of WWTP (PE > 10 000)
- Annual biogas production 24 Mm3/a
- 20.5 Mm3/a was utilised
- Electric production 27 GWh
- Heat production 80 GWh
## Biogas production

<table>
<thead>
<tr>
<th>WWTP</th>
<th>Year</th>
<th>Material</th>
<th>Reactor capacity m³</th>
<th>Biogas production (Mm³/a)</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Espoo / HSY</td>
<td>1981</td>
<td>Sewage sludge</td>
<td>2*6 000</td>
<td>2,9</td>
<td>CHP</td>
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<td>Helsinki / HSY</td>
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<td>10,0</td>
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<td>Forssa</td>
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<td>1 475</td>
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<td>Hameenlinnan seutu HS</td>
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<td>Joensuu</td>
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<td>Jyväskylän seutu JS</td>
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<td>Riihimäki</td>
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<td>Salo</td>
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<td>1962</td>
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<td>0,1</td>
<td>Heat</td>
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Barriers/Challenges to Methane Reduction, Recovery, and Use

- Size of the units is rather small
  - Large number of WWTP units which PE < 10 000

- Strong pressure to combined digesters (bio waste)
  - Increase the digestion unit dimensions and make it economically attractive
  - Negative influence to water process of WWTP (concentrated reject water)
  - 2 new combi plants had start up 2012 (Kouvola, Kokkola)

- Production subsidiary mechanism for new biogas production units started in 2010

- Support mechanism for investments which will increase energy efficiency (20-30 %)
New step for process emission control

- On line measurement of process gases was implemented in June 2012 at Viikinmäki WWTP
- Online measurement of methane, CO2, N2O etc.
- New and continuous information of process gases and correlations by Gasmet CEMII FTIR
Centralised Wastewater Treatment examples

- Wastewater treatment is centralized into two plants in Helsinki metropolitan area:
  - Viikinmäki WWTP and Suomenoja WWTP
- Biological treatment is combined with chemical treatment
  - Phosphorus is removed by chemical precipitation with ferrous sulphate
  - Nitrogen is removed biologically by nitrification denitrification process
- Side products are **sludge and biogas**.
- Biogas is used as a source of energy (CHP) in Viikinmäki
- Suomenoja bio gas is utilized as vehicle fuel by GASUM Ltd.
- Sludge is composted to the soil products
Case Viikinmäki WWTP

- 3 original 1994 gas motors (3*0.7 MW), 1 motor (1 MW) 2010, 1 motor (1.5 MW) 2012
- Biogas production 12 Mm3/a (5% wasted by flaming)
- Annual power production 23 GWh + heat 27.5 GWh (+4 GWh by heat recovery of effluent water)
- Original old gas motors will be replaced step by step – next unit in 2014 (1.5 MW)
- App. 20% increase in energy efficiency
- New engines will be equipped with gas cleaning system (active carbon)
Case Viikinmäki WWTP – ORC

- New gas motor (2012) will be combined with ORC technology
- ORC (Organic Ranking Cyckle) is under purchase process at the moment
- Investment will be supported by TEM (Ministry of employment and energy)
  - Support max level 24% of the investment
- Implementation Q4/2013
- Designed for 1.5 MW gas motor exhaust gas heat potential
  - 165 kW max power
  - 120 kW effective power generation
Case Suomenoja WWTP

- Biogas has been sold out for vehicle fuel (Gasum Ltd.) from 11/2012
- 1 original gas motor (0.6 MW) – lack of operational safety
  - Used in case of operational breaks
- Biogas production 3.5 Mm3/a
- Annual power production 5 GWh