Rebuilding Wastewater Treatment Infrastructure in Estonia

Mait Kriipsalu
mait.kriipsalu@emu.ee

Estonian University of Life Sciences
Kreutzwaldi 5, Tartu, 51014, Estonia

- Wastewater treatment as it started in 60-ies
- Highlights
- Depression in 90-ies
- Rebirth
- Situation today
Development: wastewater treatment in Estonia

- Wastewater treatment (WWTP) plants
  - Large > 2000 pe
  - Small < 2000 pe
  - On-site treatment — personal

Development: wastewater treatment

- Research 1960-s
- Wastewater irrigation.
  - No good in Estonia. Only one success story (Rannu).
- Early 60s: WWTP in 2 towns, just mechanical
- Small treatment plants for villages and farms
  - 1966 – first oxydation ditch
  - 1967 – first oxydation pond
  - 1969 – first OXYD
  - 1970 – first BIO
Development

- 2 research centers:
  - Tallinn (Tallinn Technical Uni), BIO ja OXYD
  - Tartu (Our University, EMU), oxydation ditch, oxydation pond
- National award 1972
- Export to USSR
- Typical technological solutions. Maintenance!

Oxydation ditch

- Simple
  - Activated sludge, extended aeration (24 h+)
  - Trapezoid and oval in shape (closed loop)
  - Concrete-made
  - Sand trap, blowerhouse, sieve
  - Lamella sedimentation
- Cheap
- Fool-proof aeration
- Large buffering capacity
Laminar settling unit

Locally designed, subject to failure if not maintained
Oxydation ditch

Põlva, Early 1970s

Oxydation pond – copied from nature
Oxydation pond

- Also: biopond
- Shallow pond, ca 1,2 m
- Made of soil
- Very long retention time
- N&P removal
- Cheap
- Low maintenance
- Typically used as secondary unit
Well-type treatment unit

- Based on two concrete wells
- Mechanical or pneumatic aeration
  - Design failure: problems with aeration, returnsludge, and sludge removal

![Well-type treatment unit diagram]

BIO

- Sludge-pocket type
- Fine bubble aeration with blowers
- Continuous flow, retention time 24h
- Factory-made
  - BIO 25
  - BIO 50
  - BIO 100

![BIO diagram]
BIO – problems
OXYD

- Concrete elements or monolite
- Sludge-pocket type: aerotank + settling tank
- 2 symmetrical sections
- Fine bubble aeration with blowers
- Continuous flow, retention time 24h

Larger units

- MRP-300 (and 1000) mechanical aeration
- PRP-300 pneumatic aeration
- Concrete elements or monolite
- Return-sludge by pumping
- Deep: 5,5 m or 8,5 m
Larger units

Easy to select!

Capacity

Easy to select!
Specific to Estonia

<table>
<thead>
<tr>
<th></th>
<th>Up to 2000</th>
<th>2000 to 10 000</th>
<th>10 000 to 15 000</th>
<th>15 000 to 150 000</th>
<th>Above 150 000</th>
<th>Total</th>
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<tbody>
<tr>
<td>Number of settlements</td>
<td>898</td>
<td>42</td>
<td>5</td>
<td>12</td>
<td>1</td>
<td>958</td>
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<tr>
<td>Amount of wastewater m³/a</td>
<td>14813</td>
<td>17979</td>
<td>5565</td>
<td><strong>71541</strong></td>
<td><strong>67108</strong></td>
<td>177003</td>
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<tr>
<td>% from wastewater</td>
<td>8,4</td>
<td>10</td>
<td>3,1</td>
<td><strong>40,5</strong></td>
<td><strong>38</strong></td>
<td>100</td>
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<tr>
<td>% from pollution load (BOD)</td>
<td>17,6</td>
<td>12</td>
<td>4,1</td>
<td><strong>57,4</strong></td>
<td><strong>8,9</strong></td>
<td>100</td>
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</table>

- 1050 small (<200 m³/d)
- 13 medium (200-2000 m³/d)
- 17 large (> 2000 m³/d)

Treatment plants in 1995:

<table>
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<tr>
<th></th>
<th>capacity, pe</th>
<th>amount</th>
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<tr>
<td>B 14/21</td>
<td>50 – 60</td>
<td>46</td>
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<tr>
<td>KP 21</td>
<td></td>
<td></td>
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<tr>
<td>B10 – 25</td>
<td>90 – 120</td>
<td>435</td>
</tr>
<tr>
<td>B10 – 50</td>
<td>180 – 410</td>
<td></td>
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<tr>
<td>B10 – 100</td>
<td>320 – 720</td>
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<tr>
<td>OXYD – 45</td>
<td>150 – 330</td>
<td>111</td>
</tr>
<tr>
<td>OXYD – 90</td>
<td>300 – 660</td>
<td></td>
</tr>
<tr>
<td>OXYD – 180</td>
<td>600 – 1330</td>
<td></td>
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<tr>
<td>MRP + FRP – 300</td>
<td>1050 – 3500</td>
<td>19</td>
</tr>
<tr>
<td>MRP – 1000</td>
<td>630 – 11700</td>
<td></td>
</tr>
<tr>
<td>oxidation ditch</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>oxidation pond</td>
<td></td>
<td>244</td>
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Amount of treatment units

Total

1992 – 1150!

Why?

How bad?

1966 – 1!

Year

Regression

- In 1992 – 1150 treatment units listed
  - 370 treatment plants were functioning well 😊
  - 680 functioning poorly 😞
- 1997 – 959 treatment units listed
  - 828 in operation, whereas only 58% functioning well

- Lifetime (15-20 a) expires in 90-s
- Sludge treatment not developed at all
Better again

- 1994 only 4 new units constructed
- 1997 already 29 units constructed
- 2000-s many constructed or renovated
  - New directives
  - New companies to draw projects
  - New models, materials

Environmental legislation in Estonia

- Requirements for Waste Water Discharged into Water Bodies or into Soil
  https://www.riigiteataja.ee/akt/104122012001?leiaKehtiv

Discharge limit values:

<table>
<thead>
<tr>
<th>Compound, mg/l</th>
<th>&gt; 10 000 pe</th>
<th>10 000-99 999 pe</th>
<th>2000-9999 pe</th>
<th>300-1999 pe</th>
<th>Up to 300 pe</th>
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<tr>
<td>BOD7</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>25</td>
<td>40</td>
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<tr>
<td>COD</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>150</td>
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<tr>
<td>SS</td>
<td>15</td>
<td>15</td>
<td>25</td>
<td>35</td>
<td>35</td>
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<tr>
<td>Ptot</td>
<td>0,5</td>
<td>0,5</td>
<td>1</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>Ntot</td>
<td>10</td>
<td>15</td>
<td>45</td>
<td>60</td>
<td>No</td>
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</table>
Large WWTPs

The story with large WWTPs...

Tallinn
Tartu
Narva
- We pollute Nordic coastal waters
- No better solution than aid from Nordic countries – renovate coastal treatment plants!

Tallinn WWTP
Tallinn WWTP

Tartu WWTP

Tartu is not coastal 😞
We had started in early 80-ies.
Common features

- Gravity flow targeted
- Some pumping stations
- Combined sewer is typical, stormwater drainage is developing
- Activated sludge dominates, biofilm in small installations, SBR
- Chemical P-removal typical
- By now, renovated for Bio N and P
- Membrane technologies fail
- Sludge treatment is rather poor (storing, composting, no market)
- Anaerobic treatment not common yet, but developing

Renovating infrastructure: medium-size plants

- Problem: Projects are too small, too many, too cheap!
- Solution: Combining few plants into one project!
  - Valga
  - Pärnu
  - Kuressaare
Valga

- International tendering was made by Estonian Waterworks Ltd (professionals)
- Project was made by Finnish company, practical work by local companies
- Municipality was panicing. Why?
- We made a deal to assist the municipality.

- Discussion-fight with project company
Example: Tapa

Instead of conventional tanks, earth pond was proposed.

Biolak-pendulum aeration

Example: Tapa WWTP
There are even smaller WWTPs

- Before: Each municipality had individual water supply and WWTP.
  - Each one maintained their plant by itself. No systematic approach. Lack of funds.
- Is renovation one by one even possible?
  - Too many units to scope!
  - Too much paperwork and tendering!
  - New European rules!
Big thing in Estonia

- A new ‘umbrella organisation’ was established (Emajõe Veevärk)
  - Today there are few similar Waterworks
- 30-40 WWTP were built or reconstructed during a relatively short period
- EU granted 65 M €
- Total cost?
  - Until 2008 the total cost was tripled
  - Since economic collapse the price was cut dramatically! as good news.

Municipalities involved

- Alatskivi vald (Alatskivi)
- Elva linn (Elva)
- Haaslava vald (Haaslava, Ignase, Kurepalu, Röiu)
- Kallaste linn (Kallaste)
- Kambja vald (Kambja, Vana-Ruuste)
- Alatskivi vald (Alatskivi)
- Elva linn (Elva)
- Haaslava vald (Haaslava, Ignase, Kurepalu, Röiu)
- Kallaste linn (Kallaste)
- Kambja vald (Kambja, Vana-Ruuste)

One company runs them all!

- Konguta vald (Annikoru)
- Laeva vald (Laeva)
- Luunja vald (Luunja)
- Meeksi vald (Mehikoorma)
- Mäksa vald (Kaagvere, Melliste, Võõpste)
- Nõo vald (Nõo, Luke, Meeri, Nõgiaru, Tõravere)
- Puhja vald (Puhja, Rämsi, Ulila)
- Rannu vald (Rannu)
- Rõngu vald (Rõngu, Käärri)
- Tartu vald (Kungla, Kärkna, Lähte, Saadjärve, Vahi, Vedu, Äksi, Rahinge)
- Tähtvere vald (Rõõn, Vorbuse, Haage, Ilmatsalu, Märga)
- Vara vald (Vara, Koosa)
- Ülenurme vald (Reola, Törvandi, Ülenurme)– Tarumaaal
- Palamuse vald (Palamuse)
- Puurmani vald
- Tabivere vald (Tabivere) – Jõgevamaal
- Avinurme vald (Avinurme) – Ida-Virumaal
Leevaku

[Images of a snowy area with some structures and a person standing on a platform]

[Images of technical drawings related to a facility]
The sponsor asks: how good is the situation?
We need to make an inventory
Period 2005 till 2015
Approx 260 treatment plants must be visited
A group of experts, 4 teams.
- Sampling, questionnaire, photos, background data
- Phase II – careful look 2015-2016
Wastewater treatment in Estonia

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