Suitable anaerobic technologies for Dairy resource recovery

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**Biothane’s Granular Technologies**

**Biothane Advanced UASB**
- Well proven technology with new three-phase-separator for all industrial wastewaters
- Robust, with high sCOD removal efficiency
- Restriction for SS (<1,000 mg/l) and FOG (< 100 mg/l) content

**Biobed® Advanced ESGB**
- High rate technology with new three-phase-separator for most industrial wastewaters
- Less volume, less foot-print with similar sCOD removal efficiency
- More sensitive regarding SS and FOG
Biothane’s non-granular technologies

- **Biobulk CSTR**
  - Solid waste / waste slurry digestion
  - With or without sludge recirculation
  - Suitable for high COD / FOG / SS and low flows

- **Memthane® Anaerobic MBR**
  - New technology for high strength wastewater
  - Using Cross-flow UF membranes
  - Very High COD / SS removal efficiencies
# Dairy effluent characterization

<table>
<thead>
<tr>
<th>Milk Processing</th>
<th>Cheese / Yogurt</th>
<th>Ice-cream</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Production cleaning, CIP</td>
<td>- Production cleaning, CIP, plus whey</td>
<td>- Production cleaning, CIP</td>
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<tr>
<td>- High flow rates</td>
<td>- Low flow rates</td>
<td>- Medium flow rates</td>
</tr>
<tr>
<td>- COD 1,500 – 3,000 mg/l (Proteins, Fat)</td>
<td>- COD 1,500 – 10,000 mg/l (Proteins, Fat, lactic acid)</td>
<td>- COD 3,000 – 20,000 mg/l (sugar, starch)</td>
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<tr>
<td>- TSS 300 mg/l,</td>
<td>- TSS 300 mg/l</td>
<td>- TSS 100 mg/l,</td>
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<tr>
<td>- FOG 100 – 300 mg/l</td>
<td>- FOG 300 – 1000 mg/l</td>
<td>- FOG 100 – 200 mg/l</td>
</tr>
<tr>
<td>- Usually high P, high N</td>
<td>- Usually high P, lower N</td>
<td>- Usually lower P, lower N</td>
</tr>
<tr>
<td>- Not always anaerobic applicable due to low SCOD</td>
<td>- Anaerobic applicable, sophisticated choice of technology</td>
<td>- Anaerobic applicable</td>
</tr>
<tr>
<td>- Good biodegradability</td>
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<tr>
<td></td>
<td>- Additional COD source: acid whey (COD 60,000 mg/l, very well degradable)</td>
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Case Study 1 - Ice-cream, Germany 2003

- Effluent from Ice-cream production
  - High in COD
  - Fluctuations in FOG and COD content depending on production

- Flow 800 …1,300 m³/d
- COD 3,000… 25,000 mg/l

- Pre-treatment
  - Granular sludge reactor (Biobed EGSB)
  - DAF-float to municipal digestor
  - Anaerobic effluent to municipality
  - Municipal Sludge Digestor
Case Study 1 - Ice-cream Germany 2003

Flowchart:
- Factory Effluent
- Buffer Tank
- DAF unit
- Conditioning tank
- Surplus Sludge (Municipal) Digestor
- Discharge to river
- CHP unit
Case Study 1 - Ice-cream Germany 2003

- Operational results – COD reduction

- DAF unit: total COD removal: 25 – 30 %
- FOG removal: 60 – 70%
  - to municipal sludge digester

- Anaerobic: total COD reduction: 70 – 75%
- soluble COD reduction: 80 – 85%

- Total COD reduction: 83 %,

- Biogas conversion in EGSB plant: 70% of the total COD = 2,000 Nm³/d plus extra biogas due to floating sludge in municipal digester.
Case Study 2 – Mlekovita Dairy Poland 2011

- Dairy north-east of Poland – production extension, retrofit of existing plant
- Production of milk, butter, yogurt, cream, cottage cheese
- Presence of acid whey waste stream

- High Flow = 5,000 m³/d, low temperature 20 – 25 °C
- COD load: 30,000 kg/d
  - Highly fluctuating depending on production cleaning cycles

Process choice:
- Optimized DAF separation step
- CSTR process for DAF float, acid whey and aerobic surplus sludge
  - 7000 m³ reactor
  - 20 tCOD/d
- Use of existing aerobic wwtp
Case Study 2 – Mlekowita Dairy Poland 2011

- Dairy Effluent
- Buffer Tank
- DAF unit
- Nitrification / Denitrification
- Final sedimentation
- Discharge to river
- Municipal Wastewater
- Acid Whey
- Biobulk CSTR Digestor
- Centrifuge
- CHP unit
Operating results of the anaerobic system with COD load of 18,000 kg/d

- TCOD reduction 63 %
- TSS reduction 40%
- Biogas production: 7,150 m³/d and 60 - 65% CH₄
Case Study 3 - Arla Dairy, UK

- Co-operative for processing of 1.1 billion liter fresh milk / year

- ARLA: “Arla is aiming for the dairy to be world’s first zero-carbon emission milk processing facility using cutting edge renewable energy solutions”

- Design Phase 1: COD removal – biogas production
Case Study 3 - Arla Dairy, UK

Design Phase 2:
- AnMBR extension due to production increase
- Advanced N – removal with Anitamox® deammonification MBBR process
- Advanced P - removal

Process choice:

- Memthane® Anaerobic MBR
  - 700 m³ reactor
  - 5 tCOD/d
  - 3 external cross-flow membrane skids for 550 m³/d
Case Study 3 - Arla Dairy, UK

Milk processing effluent

<table>
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<tr>
<th>Sieve</th>
<th>Buffer Tank</th>
<th>Methane digester</th>
<th>UF cross flow filtration</th>
<th>CHP unit</th>
</tr>
</thead>
</table>

Flare

Sludge Storage Tank
Permeate TCOD < 100 mg/l, TCOD removal > 99%
Producing >10% of Arla’s energy consumption out of their residues
Thank you for your attention

Questions?

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