High-Rate Treatment of Brewery Wastewater Using External Circulation Sludge Bed Technology

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The Client

- Oland Brewery, owned by Labatt Breweries of Canada, is the largest brewer in Nova Scotia
- Faced with increased discharge surcharges, newly-imposed limits on wastewater strength
- Corporate focus on environmental responsibility
- Ideal solution: on-site wastewater treatment, combined with green energy generation
Oland Brewery
Site-Specific Design Considerations

- Extremely limited space availability (<4500 ft², 400 m²)
- Close proximity to residential/commercial neighborhood
  - No odors
  - Noise limitations
  - Aesthetically unobtrusive
## Design Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent</th>
<th>Required Effluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. Flow (m³/d)</td>
<td>620</td>
<td>620</td>
</tr>
<tr>
<td>Peak Flow (m³/d)</td>
<td>975</td>
<td>975</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>5370</td>
<td>&lt; 600</td>
</tr>
<tr>
<td>COD Load (kg/d)</td>
<td>3330</td>
<td>---</td>
</tr>
<tr>
<td>BOD (mg/l)</td>
<td>3500</td>
<td>&lt; 300</td>
</tr>
<tr>
<td>TSS (mg/l)</td>
<td>700</td>
<td>&lt; 300</td>
</tr>
<tr>
<td>TKN (mg/l)</td>
<td>47</td>
<td>&lt; 100</td>
</tr>
<tr>
<td>TP (mg/l)</td>
<td>23</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>SO₄ (mg/l)</td>
<td>23</td>
<td>&lt; 1500</td>
</tr>
<tr>
<td>pH</td>
<td>---</td>
<td>5.5-9.5</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>12-25</td>
<td>---</td>
</tr>
</tbody>
</table>
Biological Treatment

Two Major types: Anaerobic, Aerobic
Both used at Oland

- **Anaerobic (ECSB)**
  - Removes the bulk of the dissolved organics and suspended matter from the wastewater
  - Converts organic matter to biogas, suitable for utilization

- **Aerobic (aeration tank)**
  - Polishes ECSB effluent to further reduce organic strength
  - Oxidizes sulfide for odour control
Biological Treatment

Anaerobic

• Organic material  $\rightarrow$ CO$_2$ + CH$_4$ + H$_2$O + bacterial cells
• Very little energy is required, only for mixing and contact
• Methane is produced, yielding energy
• Sludge yield is much less than aerobic

Aerobic

• Organic material + O$_2$  $\rightarrow$ CO$_2$ + H$_2$O + bacterial cells
• Supplying oxygen is energy intensive
• Sludge yield is significant
The Solution
Anaerobic + Aerobic Treatment

Equalization

Anaerobic (ECSB)

Aerobic

Solids Removal (DAF)

Influent Pump Station

Calamity Tank

Biogas to Utilization

Dewatering (Centrifuge)

Odour Control

Final Effluent

All in <400 m²!
High Rate External Circulating Sludge Bed (ECSB)

- High rate anaerobic treatment (15 to 35 kg COD/m$^3$d -- Oland design value = 19.4)

Picture 1: Typical granular biomass (1-3 mm) and a cross section of a granule
ADI-ECSB Technology
Reactor Tank

- **Settlers**
  - Retain granular sludge in the lower part of the reactor and transmit biogas to the NT
  - Reduce turbulence in the upper part of the reactor.
ECSB Video
ECSB Tank Placement
ECSB Tanks in Place
Aeration System

- 150 m$^3$ tank, c/w level transmitter, internal aeration piping, two aeration blowers, foam detector
  - Polishes ECSB effluent to meet discharge limits
  - Foam detector activates defoamer pump if necessary
  - Tank headspace vented to chemical scrubber
Dissolved Air Flotation

- DAF separates chemical and biological solids from the final effluent

- DAF feed pumps operate based on the aeration tank level
- Polymer addition and air bubbles float solids to the surface
- Ferric chloride addition for phosphorus precipitation
- Solids are skimmed off and pumped to the sludge holding tank
Sludge Dewatering (Centrifuge)

- Dewaters sludge from DAF
  - Estimated 3m$^3$/d sludge at 18% solids concentration
  - Thickened sludge conveyed to dumpster
  - Centrate flows to sump
  - Sump headspace vented to chemical scrubber
Chemical Scrubber

- Scrubs odorous from gases from:
  - Influent sump
  - EQ tank
  - Calamity tank
  - Aeration Tank
  - Sludge Tank
  - Dumpster
  - Centrate Sump
Biogas

• Average methane concentration of 70%-80%; an excellent “green” fuel
• Positive displacement blower withdraws biogas from the ECSB, delivers it to the brewery boiler, displacing natural gas
• ~1200 m³/d design average production (~33 GJ/d)
If the boiler is down or biogas production exceeds boiler capacity, excess flared. No biogas escapes to the environment.
Oland Brewery Biological Waste Treatment System
Oland Brewery Biological Waste Treatment System
# Latest Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent</th>
<th>Final Effluent</th>
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</thead>
<tbody>
<tr>
<td>Flow (m³/d)</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>7400</td>
<td>570</td>
</tr>
<tr>
<td>BOD (mg/l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS (mg/l)</td>
<td>--</td>
<td>270</td>
</tr>
<tr>
<td>pH</td>
<td>5–12</td>
<td>7–8</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>12–25</td>
<td>30–37</td>
</tr>
</tbody>
</table>