Waste/By-Product Anaerobic Cycle

Organic Waste

F&B by-products, Sludge, Agri-waste; animal manure

OW pre-treatments

Anaerobic Digestion

Biogas Purification

Bio-CH4 Upgrading

Digestate post-treatment

WW treatment

Sludges & bio-solids treatment

En. El

bio-CH4

off gas

WW out

bio-solid out

waste
Veolia processes in AD

<table>
<thead>
<tr>
<th>VEOLIA Technologies</th>
<th>Biomet</th>
<th>Membrane (AnMBR)</th>
<th>UASB</th>
<th>EGSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>flock</td>
<td>flock</td>
<td>granular</td>
<td>granular</td>
</tr>
<tr>
<td>Loading rate VLR (kgCOD/d/m³)</td>
<td>3-5</td>
<td>5-10</td>
<td>5-10</td>
<td>15-25</td>
</tr>
<tr>
<td>Digestor H (m)</td>
<td>12-20</td>
<td>12-20</td>
<td>6-9</td>
<td>12-20</td>
</tr>
<tr>
<td>Foot-print</td>
<td>😊</td>
<td>😊😊😊</td>
<td>😊😊😊</td>
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<tr>
<td>SS tolerance</td>
<td>😊😊😊😊😊 10-12%</td>
<td>😊😊😊</td>
<td>😊</td>
<td>😞</td>
</tr>
<tr>
<td>COD removal</td>
<td>😊😊😊 75-80%</td>
<td>😊😊😊😊😊</td>
<td>😊😊😊</td>
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</tbody>
</table>
BIOMET ® - process plus - 2 stages

- Hydrolysis: separate phase before AD: higher stability and better performances

  - Hydrolysis of proteins, carbohydrates and lipids into simple compound with lower MW → ideal substrate (COD) for methanogenic bacteria

- Mesophilic to Thermophilic → maximized efficiency

  - Constant feed of homogeneous pre-digested matter 24/24h → high stability; best control

  - Short time of daily feed → buffer result
BIOMET ® - design plus - mixing

External mixing devices with chopping pumps for a better biomass *disgregation* and easier maintenance

Internal fixed nozzles
No movable devices inside the reactors
External heat exchanger
Countercurrent → no thermal shock
big size piping → easy to clean
High flow speed → no fauling.

Digestors design
Ratio $\phi / H$ → good mixing; $<$
thermal losses; $>$ foam control
Site: Pomposa (Ferrara)
Year: 2010
Production: 1000 kW EE
Feeding: 35 kt/y
- Fruit and vegetable by-products
- Sludge from WWTP
- Vegetable by-products
Place: Graincourt - France
Year: 2012
Feeding: 25 to 50 kt/y
- slaughterhouse by-products
- dairy by-products
- vegetables by-prod.
- fish industry by-prod.
- waste from kitchen and restaurants
Site: Lodi - Italy
Year: 2016
Production: 1000 kW EE
Feeding: 34 kt/y OFMSW
Organic Fraction Municipal Solid Waste
<table>
<thead>
<tr>
<th>n</th>
<th>Client’s name</th>
<th>Place</th>
<th>Capacity</th>
<th>Inclusion/ exclusion</th>
<th>Scope of work</th>
<th>Completion start-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BOSCO</td>
<td>Brusadino place; Parma; Italy</td>
<td>Input: 20000 t/y mais silage output: 1000 kW EE</td>
<td>Incl: biogas plant Excl: CHP; Civil W.</td>
<td>Authorization design; Plant design; supply; erection; start-up</td>
<td>Jan-09</td>
</tr>
<tr>
<td>2</td>
<td>CONSERVE ITALIA</td>
<td>Pomposa; Codigoro; Ferrara; Italy</td>
<td>Input: 37000 t/y byproducts; WWTP sludge; mais silage output: 1000 kW EE</td>
<td>Incl: biogas plant; digestate dryer Excl: CHP; Civil W.</td>
<td>Authorization design; Plant design; supply; erection; start-up</td>
<td>Jun-10</td>
</tr>
<tr>
<td>3</td>
<td>SEDE ARTOIS Metha.</td>
<td>Graincourt; France</td>
<td>Input: 25000 t/y many waste output: 1000 kW EE</td>
<td>Incl: biogas plant Excl: CHP; Civil W.</td>
<td>Plant design; supply; erection; start-up</td>
<td>June 2012</td>
</tr>
<tr>
<td>4</td>
<td>AGRIFERRARESE</td>
<td>Ostellato; Ferrara; Italy</td>
<td>Input: 25000 t/y mais silage; Cow manure output: 1000 kW EE</td>
<td>Incl: biogas plant Excl: CHP; Civil W.</td>
<td>Authorization design; Plant design; supply; erection; start-up</td>
<td>July 2012</td>
</tr>
<tr>
<td>5</td>
<td>EAL COMPOST</td>
<td>Terranova dei Passerini; Lodi; Italy</td>
<td>Input: 36000 t/y organic waste output: 1000 kW EE</td>
<td>Incl: biogas plant; digestate treatment; CHP Excl: Civil W.</td>
<td>Authorization design; Plant design; supply; erection; start-up</td>
<td>December 2016</td>
</tr>
<tr>
<td>6</td>
<td>DANONE</td>
<td>Yalutorowsk, Siberia region, Russia</td>
<td>Input: 54750 t/y whey output: 300 Nm3/h biogas</td>
<td>Incl: biogas plant; sludge dewatering; biogas line Excl: Civil W.</td>
<td>Plant design; supply; erection support; start-up support</td>
<td>Commissioning January 2019</td>
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