The evaporation for the treatment of the biogas production digestate
**BIOMET™ phases**

- **Loading and pre-treatment**
- **Hydrolysis**
- **Anaerobic digestion**
- **Membrane gasometer**
- **Biogas purification**
- **Electric power production**

**Fresh substrate**
Complex Organic Compounds (carbohydrates, proteins, fats)

**Hydrolized substrate**
Simple Organic Compounds (sugars, amino-acids, fatty acids, glycerines)

**Soluble and volatile substrate**
Volatile fatty acids, alcohols etc.

**Hydrogen and carbon dioxide**

**Methanogenic phase**
Methane and Carbon Dioxide

**Acetic acid**

**Biodegradable phases**
- Fresh substrate
- Hydrolyzed substrate
- Soluble and volatile substrate
- Methanogenic phase
- Electric power production
Making the difference with engineering and process plus

- Hydrolysis as a separated step from digestion higher stability and better performances achievement

- Both mesophilia and thermophilia: optimized management of the process

- External mixing device: best biomass disgregation and easier maintenance operations

- External heat exchangers: larger diameter pipes for easier cleaning and descaling operations

- Reactors with optimal height/diameter ratio: better mixing degree, minimum thermal energy loss and reduction of foam and deposit formation

Biomass → Hydrolysis → Digestion → Biogas

- higher stability
- better performances achievement
Thinking industrial

- Digestate volume reduction (more than 10 times)

- Additional revenues from energy selling to the net
Cogeneration

ENERGY BALANCE

Fuel 100%

Thermal energy 56%

Real thermal energy 44%

Power 42%

ENERGY LOSS: 12%

GENERATOR LOSS 2%

GEAR

Fuel

Power

Exhausted gas

Hot water

ALTERNATOR

Air

Cooling

Gear and exhausted gas
Thermal energy valorization

Uses:

- Digestion process heating (whole and partial)
- District heating (exceeding)
- Digestate thermal treatment (exceeding)
VWS Italia’s solution

Thermal energy used for the treatment of digestate by evaporation/crystallization technologies
VWS Italia’s solution

PRE-TREATMENT & DEGASSING

Digestate

Solid-liquid separation

Liquid digestate

Acid

EVAPORATION/CONCENTRATION

Antifoam

Cold water
Hot water

EVALED™ AC Hot water evaporator

Distillate

POST-TREATMENT

Reverse osmosis

Discharge water/ reuse

SUPER-CONCENTRATION

Solid residue to disposal
VWS Italia’s solution

Main steps of the process:

- pH adjustment and degassing: alcalinity reduction and salification of the existing ammonia
- $1^\circ$ concentration step by EVALED™ vacuum evaporator with forced circulation and external heat exchanger
- $2^\circ$ concentration step by EVALED™ vacuum scraped unit
- Post-treatment of the condensates by two-steps RO unit (the concentrate is sent upstream the EVALED™ evaporators)
VWS Italia’s solution

Results:

- Exploitation and concentration of the liquid digestate to a shovelable consistency
- Opportunity for concentrate composting
- Transport costs reduction for an agronomical exploitation
- High quality distillate suitable for discharging or reusable as process/produced water
- Opportunity for white certificates and bonus for recovery/exploitation of thermal energy
- Flexibility: the treatment process can be made only for a part
Evaporation

Forced circulation to achieve high yields and to treat extremely fouling wastewater, with minimum maintenance

**EVALED™ EW**

- Pre-engineered, plug & play, standard units, with many references, tested and installed for several similar applications
- Minimum energy consumption
Superconcentration

**EVALED™ RW**

- Extremely high recovery percentage
- Shovelable concentrate
- Minimum maintenance

- Pre-engineered, plug & play, standard units, with many references, tested and installed for several similar applications
- Minimum energy consumption
Example

- Plant producing 999 kW using agro-industrial waste and M.S.W.O.F.
- Available thermal energy: around 1000 kW
- Thermal energy required by BIOMET™ process in thermophilia: ~ 20-25% thanks to structural optimizations of the process
- Liquid digestate quantity: ~ 30-35 ton/day
- Thermal energy required by EVALED™ EW+RW: ~ 700-750 kW

Almost complete recovery and exploitation of the available thermal energy
Example

<table>
<thead>
<tr>
<th>Parameters</th>
<th>UM</th>
<th>Inlet digestate (after solid-liquid separation)</th>
<th>Outlet condensate</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td></td>
<td>7-8</td>
<td>6-9</td>
</tr>
<tr>
<td>TS</td>
<td>%</td>
<td>2-4</td>
<td>&lt;0,1</td>
</tr>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>15-35.000</td>
<td>&lt;160</td>
</tr>
<tr>
<td>N-NH4</td>
<td>mg/l</td>
<td>2-5.000</td>
<td>&lt;15</td>
</tr>
<tr>
<td>Clorides</td>
<td>mg/l</td>
<td>1500-3000</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>mg/l</td>
<td>150-500</td>
<td>&lt;5</td>
</tr>
</tbody>
</table>

All the nutritious elements remain in the concentrate and can be exploited!!!
Mass balance

Digestate after soli-liquid separation
Flow rate: 35 m³/day
TS: 2%

EVALED™ EW 60000
Concentrate
3-4 m³/day
TS 18-20%

Dist 90-92%
37-38 m³/day

RO concentrate to evaporation
5-7 m³/day

Dist 70-75%
2.5-3 m³/day

EVALED™ RW 6000
Concentrate
1-1.5 m³/day
TS 60-65%

Concentrate
sent to agronomical exploitation or composting or disposal

RO two-steps, double pass

Permeate to discharge
33.5-34 m³/day

Total yield > 96%
Conclusions

BIOMET™ process is complete:

- Economic exploitation (white certificates/bonus): the available thermal energy would not be used otherwise
- Better management of the liquid digestate: spreading or disposal
- Digestate management even when spreading is not possible: waste contractors, industries, etc., with an optimization of the costs
- High quality produced water with reuse opportunity
Some photos
Some photos
Some photos
Thank you

VWS Italia MarCom dept.
marcom@veoliawaterst.it