Regenerative Energy from Industrial and Municipal Organic Waste

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Philadelphia, PA, USA
March 12, 2013
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Engineering Office, specialized in Design and Engineering of Biogas Plants
Foundation: 1999
Team: 25
Experience: > 25 Years
References: ca. 150 Biogas Plants
in: Germany, Japan, Netherlands, Austria, Switzerland, Lithuania, Italy, Slovakia, Canada, USA, Spain, France, Ireland, Russia and India
Partner in: Japan, Korea, USA, Canada, Bulgaria, France, Hungary, Turkey, Poland, Italy, Spain, Ireland, Serbia, Greece and China
Service offerings of Krieg & Fischer in the field of Biogas

- Studies
- Concept Development
- Calculations
- Permits & Approvals
- Engineering
- Tendering and Commissioning
- Supervision of Construction
- Start-up
- Optimization/Retrofits
- Supervision and Consulting
References - Examples

The configuration of the biogas plant depends on the substrates!
Introduction

“Regenerative Energy from Industrial and Municipal Organic Waste”

This presentation is not about the most wonderful system for regenerative energy but about the way to get there. And one of the key challenges is a proper pre-treatment.
Examples of possible substrates:

- Biodegradable municipal waste
- Potato pieces
- Potato waste
- Agricultural waste
- Banana waste
- Grape pulp
- Slaughterhouse waste
- Municipal organic waste
- Old bread
- Waste french fries
- Slaughterhouse waste
Collection of municipal organic waste – source separated
Biogas production from municipal organic waste in Germany 2011

<table>
<thead>
<tr>
<th>Fermentation container</th>
<th>Plug flow digester</th>
<th>Wet digestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>22</td>
<td>44</td>
</tr>
<tr>
<td>17%</td>
<td>28%</td>
<td>55%</td>
</tr>
</tbody>
</table>

Source: Biogas-Atlas 2011/12; Anlagenhandbuch der Vergärung biogener Abfälle in Deutschland; Witzenhausen-Institut für Abfall, Umwelt und Energie GmbH; 2011; Bioabfallvergärungsanlagen in Deutschland 2011
Contaminants of source separated municipal organic waste ("bio waste")

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Proportion (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and cardboard</td>
<td>14%</td>
</tr>
<tr>
<td>Biodegradable plastics</td>
<td>22%</td>
</tr>
<tr>
<td>Other plastics</td>
<td>12%</td>
</tr>
<tr>
<td>Metals</td>
<td>3%</td>
</tr>
<tr>
<td>Pottery, stones</td>
<td>14%</td>
</tr>
<tr>
<td>Sanitary products</td>
<td>1%</td>
</tr>
<tr>
<td>Animal faeces, cat litter</td>
<td>27%</td>
</tr>
<tr>
<td>Other material (non-compostable, risky)</td>
<td>7%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

* According to analyses the waste contains approx. 2% of contaminants

Source: Biojätteen Laatututkimus, 2010; Finland
Key question:

How does the pre-treatment looks like?
Pre-treatment

What is the aim ???

Input quality

Pre-treatment

Output requirements
Pretreatment

“clean” waste

- minor preprocessing
  (shredding if necessary)

- digester

contaminated waste

- pretreatment
- removal of big contaminants
- shredding
- removal of Fe
- removal of non-Fe
- removal of grit
- conditioning
- removal of light contaminants

- digester
Pre-treatment

Input quality

Pre-treatment

Output requirements
Selection Process technology

Depends on:

– Kind of Substrate
  • Dry matter content
  • Amount of contaminants
  • Content volatile solids
  • Particle size
  • Seasonal variation

– Location
– Logistic
– Use of digestate
Noyon
Delivery liquid waste
Noyon
Delivery solid waste
Pre-treatment

Doppstadt-Zerkleinerer AK 230 E

Walzenzerkleinerer DW 2060 - E „Büffel“

Trommelsiebmaschine SM 518 A

Krieg & Fischer Ingenieure GmbH
Speaker: Torsten Fischer
March 12, 2013
Pre-treatment
Pre-treatment

Cross flow shredder
Pre-treatment

Source separated organic household waste

- Shredding <100 mm
  - Sieve <80 mm
    - Contaminants (plastic, wood etc)
    - Metall separator
      - Metalls (NE, Fe)

Wet pretreatment

- Contaminants (stones, bones, foils, wood)
- Sediments (sand, stones, pottery...)
  - Pulper
    - Grit removal system

Dry pretreatment

- Shredding <15 mm
  - Sieve <12 mm
    - Press
      - Contaminants

Mixing tank

- Recirculated process water

Homogenous substrate for anaerobic digestion
Example 1: waste from sugar industry

**Pretreatment:**
Different silage plates → solid input device (red framed area)

**Digestion:**
→ 4 Digester → secondary digester (green framed area)
Sugar industry
Dinteloord, The Netherlands

- Built: 2011
- Substrate: sugar beet ends, sugar beet leafs, sugar beet, vegetable waste 114,000 t/a
- Digester: 4 x 4,480 m³ steel tank
- Upgrading of 1,750 m³/h biogas to 990 m³/h methane
- Gas holder above secondary digester
- Treatment of digestate with decanter
Example 2: “clean“ organic waste from industry

Pretreatment:
Different tanks for delivery → shredding → mixing tank (red framed area)

Digestion:
→ Digester → secondary digester (green framed area)
Sludge from food industry, kitchen and market waste  
France, Noyon

- Built: 2007  
- Substrate: 40,000 t/year fluid and solid organic waste and sludge  
- Digester: steel tank 3,479 m³  
- Gas engine: 716 kWe  
- Solid-fluid separation of the digestate
Example 3: municipal organic waste

Pretreatment:
Different tanks for delivery
→ screw mill/bag opener
→ interim bunker →
pulper → grit removal
system → buffer tank →
mixing tank → hydrolysis
(red framed area)

Digestion:
→ Digester → secondary
digester
(green framed area)
Type of digestion

- **Constant type**
  - Wet digestion
    - TS <15% (in digester)
  - Dry digestion
    - TS 20-30% (in digester)

- **Batch type**
  - Dry digestion
    - TS 30-40% (in digester)

**Garage digester**

**Plug flow digester**
Type of digestion

- Constant type
  - Wet digestion
    - TS <15% (in digester)
  - Dry digestion
    - TS 20-30% (in digester)
- Batch type
  - Dry digestion
    - TS 30-40% (in digester)

Garage digester

Plug flow digester

Wet digestion
Main criteria wet/dry digestion

Suitability organic waste for dry digestion or wet digestion:

- Green waste
- Bio waste (rural)
- Bio waste (urban)
- Organic commercial waste
- Kitchen waste
- Catering waste
- Food waste
- Slaughtering waste

Increasing humidity
Increasing structure
Conclusions:

- Clear definition of the input substrate is inevitable for every proper selection of pre-treatment components.
- Clear definition of the output quality needs to be done prior to selection of pre-treatment aggregates.
- The chosen pre-treatment equipment influences the digester volume and system.
- Nothing is simple.
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