Biogas From Organic Waste From Cities

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Krieg & Fischer Ingenieure GmbH

Engineering Office, specialized in Design and Engineering of Biogas Plants

Foundation: 1999

Team: 29 employees

Experience: > 25 Years

References: ca. 150 Biogas Plants

In: Germany, Japan, Netherlands, Austria, Switzerland, Lithuania, Italy, Slovakia, Canada, USA, Spain, France, Ireland and Russia
Service offerings of Krieg & Fischer in the field of Biogas
沼气领域内K&F提供的服务

- Studies 调研
- Concept Development 创新发展
- Calculations 核算
- Permits & Approvals 许可和审批
- Engineering 工程
- Tendering and Commissioning 投标和试运行
- Supervision of Construction 建设施工
- Start-up 启动
- Optimization/Retrofits 优化设计
- Supervision and Consulting 监理和咨询
The configuration of the biogas plant depends on the substrates!
Demo-Projects and first order K&F in China
Collection of BMW in Germany

Separation of waste in households:
- paper
- plastic and metals,
- organic waste,
- residual waste

Organic waste consist of kitchen waste and garden waste.
Biogas production from BMW in Germany 2011

BMW Biological Municipal Waste=
Source separated household waste

<table>
<thead>
<tr>
<th>Wet digestion</th>
<th>Plug flow digester</th>
<th>Fermentation garage type</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>55%</td>
<td>28%</td>
<td>17%</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
Biodegradable municipal waste (BMW) in Germany
Use of digestate in Germany

**after 1990**

- BMW
  - Biogas
  - Digestion
  - Use as fertilizer
  - Recycling of nutrients

**before 1990**

- Organic fraction of MSW
  - Contamination with heavy metals
  - Biogas
  - Digestion
  - Incineration /landfilling
  - Loss of nutrients
Content of heavy metals in Germany

Main Question:

What do you want to do with the output (digestate) of the biogas plant?
Pre-treatment

Input quality

Pre-treatment of BMW

Output requirements
Municipal solid waste (MSW) in China

Amount recoverable matter:
- Organic matter 78%
- Wood 1%
- Paper 6.5%
- Plastic 6.8%
- Glass 1.5%
- Metall 0.3%

Source: Raninger et al. 2011, In: Biogas Engineering and Application

All in all there is a poor data basis for BMW in China!
Comparison of **Biodegradable Municipal Waste** between China and Germany

<table>
<thead>
<tr>
<th></th>
<th>Chinese BMW</th>
<th>German BMW (City)</th>
<th>German BMW (Rural)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dry matter content</strong></td>
<td>mean</td>
<td>high 25%</td>
<td>higher 25-35%</td>
</tr>
<tr>
<td><strong>Garden waste</strong></td>
<td>- 2,1%</td>
<td>mean amount</td>
<td>high amount</td>
</tr>
<tr>
<td>wood/bamboo (Ranninger 2007)</td>
<td></td>
<td>(depending on location)</td>
<td></td>
</tr>
<tr>
<td><strong>Contamination</strong></td>
<td>low</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td><strong>Seasonal variation</strong></td>
<td>depending on climate</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td><strong>Salinity</strong></td>
<td>high</td>
<td>mean</td>
<td>low</td>
</tr>
<tr>
<td><strong>Compostibility</strong></td>
<td>bad</td>
<td>not so good</td>
<td>good</td>
</tr>
<tr>
<td><strong>digestibility</strong></td>
<td>good</td>
<td>treatment needed</td>
<td>not good</td>
</tr>
</tbody>
</table>
## Chinese BMW in Comparison to European Organic Waste Definitions

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<th>wet fermentation</th>
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<tr>
<td><strong>Green cut</strong> biowaste (rural)</td>
<td>Chinese BMW</td>
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<tr>
<td>Biowaste (city)</td>
<td>waste slaughterhouse</td>
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<tr>
<td>organic industrial waste</td>
<td>liquid organic waste</td>
</tr>
<tr>
<td>kitchen waste</td>
<td>food waste</td>
</tr>
<tr>
<td>waste of restaurants</td>
<td>increasing water content</td>
</tr>
<tr>
<td>increasing structure</td>
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Main Question:

Good quality of output (digestate) - What does this mean?
Digestate quality criteria in Germany

Digestate used as fertilizer need to fulfill the following criteria (RAL GZ 251)

- Sanitation: <2 seeds/l, no Salmonella
- Contamination: < 0.5 % dry matter content
- Grade of degradation: <1500 mg organic acids/l
- Odor: no bad smell
- Heavy metals: specific limits, for example <100 mg/kg Pb

Pre-treatment influence the quality of digestate!
Pre-treatment

- Input quality
- Pre-treatment of BMW
- Output requirements
Main Question:

How does a good pre-treatment look like?
Pre-treatment

Source separated organic household waste

Shredding <100 mm

Sieve <80 mm

Contaminants (plastic, wood etc)

Metall separator

Metalls (NE, Fe)

Contaminants (stones, bones, foils, wood)

Pulper

Sediments (sand, stones, pottery...)

Grit removal system

Mixing tank

Homogenous substrate for anaerobic digestion

Dry pretreatment

Shredding <15 mm

Sieve <12 mm

Press

Contaminants

Recirculated process water
Pre-treatment

Doppstadt-Zerkleinerer AK 230 E
Walzenzerkleinerer DW 2060 - E "Büffel"
Trommelsiebmaschine SM 518 A
To be paid attention to:

- Season (Summer, Winter, Spring, Autumn)
- City – Rural Areas
- Celebration Days
- Education of People
- Single Family Houses – Skyscrapers
- Area with Habits (North, South, East, West)
- ....
Pre-treatment
Pasteurisation in Germany

Biological municipal waste may contain germs and pathogens, seed and parasites.

- Pasteurisation (70° C, 1 h, particel size <12 mm)
Type of digestion

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

Continuous stirred tank reactor (CSTR)(digester)

Plug flow digester

Garage digester
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Solid fertilizer from BMW in Germany

- Solid fertilizer from BMW (Göttingen)
Treatment capacity

Depend on

- Total amount of waste delivered [t/a, t/d, t/h]
- Number of working days per annum [250 – 300 ?]
- Number of working hours per day [shifts]
- Operation time of pre-treatment
- Peak amount of delivery (seasonal variation, weekly variation)
- Size of delivery trucks
- Capacity of Reception
Anaerobic Treatment of Organic Waste from Cities - Lessons learned

• How much BMW per day/week/year?
• What logistic of delivery?
• How high shall be the capacity of the reception?
• What is the input quality?
• What is the output quality?
• What pre-treatment?
• What type of digestion?
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