BIOWERT GRASS
BIOREFINERY
BIOBASED PLASTICS, GERMANY
PLANT CONCEPT AND FRAMEWORK

CONDITIONS

We live in a world with significant concerns related to climate change and an associated need to reduce significantly use of fossil resources; this necessitates supply of energy and products from renewable sustainable resources. The principle of biorefineries is resource-efficient utilisation of bio-based raw materials. Based on this concept, the Biowert Industrie GmbH was founded by Michael Gass in 2000 as a Swiss-German company. The first Biowert grass refinery started operation in 2007 and is located in Brensbach, Germany, on an 18,000 m² site (Figure 1).

The main products based on grass from permanent pastureland and arable land for crop production are grass fibre insulation (AgriCell®), natural fibre reinforced plastic (AgriPlast®, Figure 2) and fertiliser made from digestate (AgriFer®). The facility has an annual throughput of about 2,000 t dry matter (equivalent to 8,000 t grass per year at 25%–30% dry matter content). The integrated biogas plant produces c. 1,340,000 m³ of biogas annually which is used in combined heat and power facilities, which in 2012 produced 5.2 GWhel of electricity.

The Biowert cycle is shown in Figure 3. Grass is stored within bunker silos, where the ensiling process takes place. The first step after ensiling includes mechanical treatment of grass silage and isolation of grass fibres through pulping, drying and pressing processes. The grass fibres are further processed into AgriCell® and AgriPlast® synthetic granules. AgriPlast® contains 30–50% grass fibres and 50–70% recycled polyolefine and is used for injection moulding for a range of uses (Figure 2).

The grass juice remaining from mechanical pretreatment of grass silage is used as substrate in the biogas plant (together with local co-substrates such as food waste and slurry). The heat and electricity derived from the biogas facility is used to satisfy the energy in the biorefinery and excess electricity is exported to the electricity grid. Wastewater arising from the process is reused for pretreatment (slurrying) of grass silage. Digestate from the biogas plant is further processed to a concentrated and a liquid biofertilizer (AgriFer®) used by local farmers. This closes the nutrient cycle in the circular economy.

Figure 1: Biowert grass refinery located in Brensbach, Germany
**PROCESS DATA**

The process combines production of bio-based materials within the grass biorefinery and a biogas CHP plant (Table 1). Grass juice and other biogenic residual materials (such as local food waste) are used for biogas production.

**ECONOMIC AND ECOLOGIC ASPECTS**

Relatively high sale prices of material products (AgriPlast\textsuperscript{BW} and AgriCell\textsuperscript{BW}) as well as the integration of two product options (insulation or bioplastic) allows flexibility to market changes. These are key factors for successful concept implementation. Rising electricity prices make future energy use from the biorefinery-associated biogas plant even more attractive. Table 2 summaries the environmental evaluation of the grass biorefinery.

---

Table 1: Input and output of the grass refinery and its associated biogas and CHP plant (Brensbach, Germany)\(^a\) data based on 2007 – 2012 period

<table>
<thead>
<tr>
<th></th>
<th>Grass refinery</th>
<th>Biogas &amp; CHP plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>8,000 t/ year</td>
<td>Grass juice: 1,942 t/ year</td>
</tr>
<tr>
<td>Electricity demand</td>
<td>2.5 – 3 GWh\textsubscript{el}/ year</td>
<td>Co-substrates in biogas facility: 15,260 t/ year</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td>AgriCell\textsuperscript{BW}: 1,410 t/ year</td>
<td>Biogas: Approximately 1,340,000 m\textsuperscript{3}/ year at methane concentration of 60 %</td>
</tr>
<tr>
<td></td>
<td>AgriPlast\textsuperscript{BW}: 2,500 t/ year</td>
<td>AgriFer\textsuperscript{BW} concentrated and AgriFer\textsuperscript{BW} liquid digestate: 11,362 t/ year</td>
</tr>
<tr>
<td>Electricity production</td>
<td></td>
<td>5.2 GWh\textsubscript{el} in 2012</td>
</tr>
</tbody>
</table>
OUTLOOK

The utilisation of grass for energy and raw material production is an example of the bioeconomy connecting agriculture and industry; such models provide for future expansion and diversification in the agricultural sector. The vision for the Biowert grass biorefinery is to develop two further grass refineries within the next three to five years.

Table 2: Environmental Evaluation of the grass refinery

<table>
<thead>
<tr>
<th>Environmental evaluation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 5 GWhel/year renewable energy production</td>
</tr>
<tr>
<td>• 100% recyclable products</td>
</tr>
<tr>
<td>• Ecological footprint reduction (lower ecotoxicity compared to petrol-based plastics)</td>
</tr>
<tr>
<td>• Process water recycling</td>
</tr>
<tr>
<td>• Lower transport costs (local sources)</td>
</tr>
</tbody>
</table>

IEA Bioenergy Task 37
“Energy from Biogas”
http://task37.ieabioenergy.com

CONTACT
VERA SCHWINN
Quality Manager – Biowert Industrie Gmbh
Gewerbegebiet Ochsenwiesen, Ochsenwiesenweg 4
64395 Brensbach/Odw.
t +49 (0) 6161 80 66 30
f +49 (0) 6161 80 66 318
v.schwinn@biowert.com
www.biowert.com

Further Information
IEA Bioenergy Website
www.ieabioenergy.com
Contact us:
www.ieabioenergy.com/contact-us/

IEA BIOENERGY
The IEA Bioenergy Technology Collaboration Programme (www.ieabioenergy.com) is a global government-to-government collaboration on research in bioenergy, which functions within a framework created by the International Energy Agency (IEA - www.iea.org). As of the 1st January 2016, 23 parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Norway, South Africa, Sweden, Switzerland, the United Kingdom, the USA, and the European Commission.

The mission of IEA Bioenergy is to increase knowledge and understanding of bioenergy systems in order to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive bioenergy systems and technologies, and to advise policy and industrial decision makers accordingly. The Agreement provides platforms for international collaboration and information exchange in bioenergy research, technology development, demonstration, and policy analysis with a focus on overcoming the environmental, institutional, technological, social, and market barriers to the near- and long-term deployment of bioenergy technologies.

IEA Bioenergy, also known as the Technology Collaboration Programme (TCP) for a Programme of Research, Development and Demonstration on Bioenergy, functions within a Framework created by the International Energy Agency (IEA). Views, findings and publications of IEA Bioenergy do not necessarily represent the views or policies of the IEA Secretariat or of its individual Member countries.