Biogas Regions
Shining Example

# GEVEKE BIOGAS PLANT

## From cultivation to fermenter – Recommendations to optimise gas fermentation

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Gas fermentation is a rather comprehensive topic. We have been operating a biogas plant for 2 ½ years, predominantly using grass, and are learning and improving something every day. For that reason, this speech can only elucidate certain aspects of the topic.

We operate a 500kw biogas plant in Ammerland near Oldenburg in a dairy cattle region. Charging is with ¾ grass silage, maize remnants. The plant was designed for that right from the start and is not being operated with grass by coincidence. We cultivate ca. 75 ha grassland and 7 ha maize fields. Depending on the offers, we still purchase 30-50 Ha maize annually on top of that. Furthermore, we buy ca. 100 ha 3rd cuttings and in late autumn extensively harvest the "clear cuttings" from grasslands in our greater surroundings (ca. 15-20km radius)

Certainly, maize is definitely "the" energy plant at the moment. This is not about displacing the maize, but rather about the question what we will make with the permanent grass areas in the Altmarsch (old marsh), in soil near groundwater and moorland. These areas are a part of the landscape and cannot be ploughed. However, these areas are often less intensively used or they are "left over", so the question arises whether one can use these areas purely for energy production

Fundamentally, three types of grass procurement are available:

1. Year-round usage of permanent grasslands, 100% fertilization with fermented substrate, harvest middle to end of panicle emergence (3-4 cuttings per year)
2. Proportional use of meadow lands together with dairy cattle operators: The 3rd and 4th cut is often left over here, making it less expensive to procure. An area surplus is often available due to the 170kg N limit.
3. The purchase of surplus grass silage due to feed surpluses.

From all 3 variants, the best cost optimized solution can be found for the biogas plant.

If the permanent grassland is cultivated exclusively for biogas, one needs to pay attention to a few things during intensive usage. The turf sward should contain good grass types to achieve high mass yields, and also to get relatively uniform ripening. That results in higher harvest yields with low lignin content. That would too strongly load the mixers or agitators in the fermenters.
If the 3rd or 4th cut is purchased from other operators, they can be purchased relatively cheaply. When setting prices, the extensive logistics costs for grass and the long distances must be taken into consideration. As the biogas plant rather appears as a "problem solver" however, one can often find good solutions for that.

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The advantage of late cuts is the low panicle formation and long mass growth without strong lignin deposits, so many areas from various organisations can be moved together without any disadvantage for one date.
That which is offered again and cannot be used in the biogas plant is nature-preservation grass or similar, later. Overly large lignifications are to be expected here which will make the harvest and the fermentation unprofitable.

The grasslands can be optimally economically fertilized with fermented substrate and applied ground-proximate. The nitrogen availability is good and the other nutrients are also available to the plants very quickly. A closed nutrient cycle results from the grasslands for biogas utilization without additional mineral fertilizers.

The grass harvest should then be very quickly processed: Mowing – briefly wilt – swath – chop, at best within 36 hours. With that one attains "still moist" crops that can be very quickly degraded in the fermenter. For us, 7-8 mm theoretical cut length has proven to be the economically most optimal chopping length. Shorter lengths load down the chopper and slow down harvesting. The often emerging acetic fermentation in later cuts is rather desirable for biogas. It is exactly this cutting that allows very good fermentation. For that reason, we like to sometimes also harvest a 5$^{th}$ cut in mid November...

Using corresponding technology, a good gas yield can be gained from grass in the fermenter. Depending on the quality and weight (!), 170-200 m³ per ton can be gained. Use a loosening technique when feeding as the grass sticks together rather a lot and needs to be separated before charging.
Important during mixing is that slow-running and large-bladed mixers or agitators are used as the pulp tends to be difficult to mix and scum layers must be prevented.
For pumping, ensure short suction routes and pump technology that is also capable of pumping viscous "pulp". Especially with grass, it is very important that the dry substance content in the fermenter can be regulated as there is often a lack of liquid in higher dry content. This is feasible using recirculation from the refermenter. However, it is more effective to separate before final storage to deliberately return part of the liquid.

**Conclusion:**

Grass fermentation is an interesting alternative for intensive grassland usage. Using late cuttings in dairy cattle operations can also be very interesting commercially. If chopping is then done correspondingly short and the fermenter is adapted to the "pulpy" circumstances by using corresponding mixing and pumping technology, a biogas plant in a grasslands region can be very interesting. At the latest, the discussion about foodstuffs "contra" bio energy could once more lend grass usage new momentum.

## key data

Operator……………………………………………..**Jens Geveke/Farmer**

Location……………………………………………**Westerstede-Ihausen/ Niedersachsen**

Commissioned……………………………………**12/2005**

Type of plant………………………………………**Wet fermentation**

Amount of gas produced ………………………...**2,665 Mio m³** per year

Planner/Manufacturer……………………………**Own construction/BioConstruct**

Cost ………………………………………………...**1.800.000 Euros**

Source: „Good Practice“ Biogasanlagen in Niedersachsen, Sachsen-Anhalt und Schleswig-Holstein, Page 27, 1st Edition November 2007

## feedstock

Grass silage…………………………………………………….... **11.315 tons** per year

Maize silage ……………………………………………………... **1.022 tons** per year

Cattle manure……………………………………………………...**1.460 m³** per year

Ensiled corn cobs with leaves…………………………………… **584 tons** per year

In 2009 the cattle manure will be increased by 30 %.

## production data

Biogas volume…………………………………………………… **2,520 m³** per day

Available area for the output of the biogas fertilizer ……….. **75 ha own grassland, 7 ha field, rest to other farmers**

CH4 content…………………………………………………… **53.5 %**

CHP………………………………………………………………. **CES - Continental Energy Systems 190 kW MAN gas motor**

Furnace thermal capacity…………………………………….**470 kW**

Thermal power of the gas engine ……………………………. **670 kW**

Electric power of the engine………………………………….**537 kW**

Generated thermal energy……………………………………. **Exhaust gas heat exchanger will be established with the district heating network**

Utilisation of heat ……………………………………………..**240.000 kWh/a for 2 houses and machine shop; in the future further 30 houses**

Generated electric energy …………………………………….. **4,45 Mio kWh/a**

Power consumption (electricity) of the plant itself …………..**7,5 %**

Annual delivery of electricity to the (regional) electric grid company

**4.45 Mio kWh per year**

Electric grid company…………………………………………..**EWE AG**

Electrical efficiency…………………………………………… **40.5 %**

Thermal efficiency…………………………………………….. **44.5 %**

Total efficiency………………………………………………… **85.0 %**

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## technical plant description

Digester ………………………………………………………….. **1000 m³**

Second digester ………………………………………………. **1000 m³**

Postdigester……………………………………………………..**1000 m³**

Final storage…………………………………………………….**3600 m³**

Operating temperature…………………………………………..**48°C**

Residence time in the digester ………………………………. **~ 90 days**

Average expenditure of human labour ……………………….. **2,5 hours** per day

By increasing temperature a far better liquefaction of the substrates was achieved. Therefore there are a better energetic use and independence from increased prices of agricultural products.

Source: „Good Practice“ Biogasanlagen in Niedersachsen, Sachsen-Anhalt und Schleswig-Holstein, Page 27, 1st Edition November 2007

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