



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 5th 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.



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Biogas Regions Shining Example



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

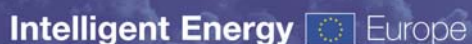
Source: „Good Practice“ Biogasanlagen in Niedersachsen, Sachsen-Anhalt und Schleswig-Holstein, Page 27, 1st Edition November 2007

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 %.

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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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Biogas Regions Shining Example



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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