



Biogas Regions Shining Example



Biogas plant Karl-Heinz Engert

A biogas plant is presented below which predominantly ferments grains. Pure grain fermentation has barely asserted itself up to now even though from an energy point of view it is very interesting because gas extraction of up to 400 litres of methane per kg o DS have been measured and the high level of energy density promises low spatial needs for transportation, storage, fermentation and application on top of that. One major reason for that is certainly the rapid acidification tendency of this substrate. Grain decomposes extremely quickly and leads to rapid acidification in the fermenter. Using the conventional one-stage process, the acidification cannot be buffered if there is too much grain and the process comes to a standstill.

However, a two-stage system in which the acidification occurs in a separate stage, preventing interference in the methane formation process in the 2nd stage, was seldom economical in the past. But now the context has been improved and, through the NaWaRo bonus, it is easier to get financing for the accessories required for the process engineering. For that reason, interest in pure grain fermentation has grown. Practical experiences, however, will only be available in some years.

The plant in the Engert operation (97258 Uffenheim, OT Rodheim) was completed at the end of 2005 and exhibits the state of the art: daily, about 5 tons of corn (grain, maize) and ca. 6 m³ cattle manure from the hydrolysis stage (the 1st fermentation stage) are conveyed into the actual fermenter. The cattle manure comes from four local operations and is picked up by the operator himself. In return, the farmers pick up the fermented manure from the 2000 m³ disposal site, which is located on the plant premises. Part of the required substrates is grown on the operation's own areal (40 ha) and the remainder is procured externally.

In the grain delivery hall, 630 tons of grain is processed for a dry silo and ca. 350 t (500 m³) for a wet silo (ligavator from the company Lipp). The advantage of wet storage is that corn threshed longer during harvesting and corns with a moisture content of up to 25% in grains and up to 40% in maize corns can be stored. The dry grain is threshed, mixed in a paste maker (Ligamix from Lipp Co.) with water and pumped into the ligavator. This substrate, as compared with silo maize, has three times the energy density.

About every 6 days, a new mixture is charged in the hydrolysis container. To do that, 30 m³ ligavator pulp, already acidified through storage (pH 3.9 and 50% solids), is pumped into the hydrolysis pit. In addition, the cattle manure and recirculated product from final storage are added so that the dry content of the mixture is about 26%. The hydrolysis container with 160 m³ capacity is equipped with a powerful, stationary paddle-type agitator (from the company Rohn, 12 kW power) so other substances like silo maize can also be co-processed. The agitator runs approximately every three hours for 2 minutes. The hydrolysis is heated; the temperature is set between 10 and 40°C depending on the type of substrate.

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The retention time in hydrolysis is about 6 days. Every 3 hours, ca. 2.5 m³ substrate are pumped into the fermenter (1000 m³ steel fermenter from the company Lipp with integrated 300 m³ gas accumulator). That amounts to a retention time of 50 days. The agitator in the fermenter is a flow conduction pipe with an integrated rod mixer and a power of 2 x 18 kW. It is run 8 times daily 8 for ca. 15 minutes. The fermenter is run at an operating temperature of 38°C. The loading rate lies at about 3 kg o DS/ m³ and day. The plant is automatically controlled by a PC. Remote data monitoring is possible. The desulphurization is performed by flowing in air. The gas analyzer from the company Chemec continuously measures sulphur, methane, CO, and oxygen.

The gas is converted into electricity in a 324 kW gas engine unit from the company MDE. It has an electrical efficiency of 36.5%. One can then calculate that an average power of 300 kW can be generated continually (365 days/a). The heat is utilised nearly 100% by ten connected residential houses and 2 stalls. For that reason, the plant receives the cogeneration of heat and power bonus. The local heating network and the substitute heating oil burner with 220 kW power were financed by the 10 participating households. Per household, about 6,000 to 7000 € investment costs arose, which are accounted for via heat delivery. 50% of the heating oil price will be calculated as the heating price.

According to the planners, the investment costs of the plant without heat connection lies at 3000 - 3500 €/kW.

The operating costs cannot be exactly estimated at this time. The plant designers calculate 1 hour per day as the labour-time expenditure. In comparison with other [renewable raw materials](#) plants, that is extremely little (ca. 30%). As charging with grain or corn requires much less time and everything is more or less automatic, the labour-time expenditure can even be significantly reduced.



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key data

Operator.....	Karl-Heinz ENGERT
City.....	Rodheim
Start of Operation	2005
Planning/ Construction.....	Company ROHN (System Lipp)
Investment costs	Biogas plant: 920,000 € total heating network: 58,000 €
Amount of gas produced	1,41 Mio m³ per year

feedstock

Externally procured manure.....	7.300 m³ per year
Silo maize.....	1.825 m³ per year
Rye.....	2.000 tons per year
Wheat	180 tons per year
Mangel-wurzel (turnips).....	1.000 tons per year

The mangel-wurzel (turnips) are mixed with chopped straw and then stored in the horizontal silo sandwich-wise.

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production data

In the village, a syndicate was founded for heat utilization which includes the operator and 9 neighbours. Based on their individual heat consumptions, they financed the heat network with varying shares (5,500 – 8,000 €). Up to amortisation of the plant (about 2 years), the 10 shareholders received heat free of charge. The basis for the concluding heating-price is half (referenced to the energy content) of the heating oil price. An oil burner is available as emergency heating (safety reserve).

Available area for the output of the biogas fertilizer	200 ha
Thermal power of the gas engine	385 kW
Electric power of the engine.....	324 kWa
Generated thermal energy.....	2,19 kWh/a
Generated electric energy	2,61 Mio kWh/a
Utilisation of heat	in winter the heat is completely used by 10 houses and 2 stables, in summer it is used by 70%
Power consumption (electricity) of the plant itself	170.000 kWh/a
Annual delivery of electricity to the (regional) electric grid company	2,6 Mio kWh per year
Electric grid company.....	Firm Energie

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technical plant description

Operating temperature.....	40°C
Residence time in the digester30 days
Average expenditure of human labour	1,5 hours per day
Wet preservation: using LIPP ligavator	496 m³
Reception pit.....	150 m³
(heated external hydrolysis stage, equipped with 18.5 kW Staro agitator)	
Fermenter: LIPP combi bioreactor.....	1.000 m³
with feed chute mixer and high-gravity solids extraction.	
Final storage: LIPP Spiral-fold engineering	2.000 m³
BHKW.....	MDE gas motor 300kW



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