Project Outline

Performance Improvement of existing NaWaRo Biogas Plants

By Anselm J. Gleixner, Managing Partner of INNOVAS GbR

1. Initial Situation

Due to the sharp increase in raw material costs (production costs) for silages of NaWaRo, (means renewable raw materials), the profitability of biogas plants is becoming very thin. This affects as more fatal as worse the biomass is exploited.
Especially with many single-stage biogas plants, which were built in the wake of the EEG (Erneuerbare Energien Gesetz = German Renewable Energy Sources Act**),** the degree of degradation of the added organic is often only 50 to max. 60%.
This means that far too much of the expensive produced raw material is going back unused to the fields. And, much more biomass must be used for the energy production as it would be necessary if the plant is working optimally.

For our modification model we chose the **plant size "500 kW$_{el}$"** because these plant sizes were the most popular constructed size due to the structure of EEG tariffs.

2. Performance / Potential

The following example illustrates the potential that can be used for improving the economic efficiency.

Degradation	Input maize silage	CHP Power	Electricity yield
60 %	11,200 t/a	500 kW	4,370 MWh/a
80 %	9,000 t/a	500 kW	4,370 MWh/a

If additionally most of the crude fiber is also decomposed and subsequent digested, a degree of degradation of up to 90% of the supplied organics is possible:

Degradation	Input maize silage	CHP Power	Electricity yield
85 %	8,500 t/a	500 kW	4,370 MWh/a

For the same power yield you would need 20 - 30% less silage. Assuming procurement costs of 45.00 /t for the silage, the material savings (less operating costs and invest) will **increase the annual net earnings from 50,000 € up to 75,000 € per Year.**

3. Approach

The solution is an at least two-stage biogas process, means the division of acidification with hydrolysis and the methanization in spatially separated tanks and a suitable crushing unit before.

The optimal digestion of the biomass and thus the highest possible degree of degradation and biogas yield can be achieved with an additional enzymatic treatment.

At this point we don't want to explain the anaerobic digestion process and biogas formation more In details, but the nature shows us that the two-stage process is the right. Seen on the "function" of a cow. If the feed is just as optimally prepared and digested like a ruminant, the fed biomass can be optimally utilized.
For more details regarding the basics of anaerobic processes we provide some more information on our website.

4. Solution

Of course, the solution concept must be adapted to the built and existing technology.

There are Biogas plants which are only operated with NaWaRo (maize and/or grass silage, whole crop silage) as a mono-substrate and in which the biomass is feed directly into the fermenter via special stuffing screws or flushing devices.
In other plant concepts, the biomass is first mixed together with liquid manure or recirculates in a mixing tank and then pumped into the fermenter. Partly crushing units are in use and sometimes the material is feed without any further cutting.

The technical solution of the optimization must therefore be flexible to meet the differences of the given plants.

4.1 Optimization version 1 (up to **80% degree of degradation**, without enzymatic decomposition)

The main changes and enhancements to the biogas plant are:

• Mixing tank made of concrete, with feeding chute and a powerful agitator	ca. 65,000 €
• Hydrolysis stage, closed reinforced concrete tank, inside coated, insulated around, with internal heating and agitator	ca. 170,000 €
• Additional transfer and filling pump, piping and fittings, steel construc tion and pro-rata assembling	ca. 55,000 €
• Biofilter, exhaust air treatment with piping and installation	ca. 35,000 €
• Extension of the control system and electrical installation	ca. 15,000 €
• Pro-rata planning and design costs	ca. 10,000 €
• Project management, functional testing and commissioning	ca. 20,000 €
• Optional: additional grinder (e.g. BioCut)	ca. 30,000 €
Total investment costs	ca. 400,000 €

The aforementioned investment costs can be significantly reduced if existing plant technique can be modified, e.g. reconstruction a pre-fermenter or pre-tank as hydrolysis stage or as a mash and mixing tank. The cost calculation must always be made individually and project-related.

4.1.1 Economy Optimization version 1

Cost reduction of biomass	2,200 t/a	á 45.00 €/t	ca. 99,000 €/a
Cost reduction for mixing energy	90,000 kWh/a		
Add.: Energy for cutting and hydrolysis	ca. 60,000 kWh/a		
Balance	ca. 30,000 kWh/a	á 0.15 €/kWh	4,500 €/a
Sum of possible savings			ca. 103,500 €/a
Additional operating costs			0 €/a
Financing costs	2.5	% p.a.	ca. 10,000 €/a
Depreciation of the Investment	10	Years	ca. 40,000 €/a
Total estimated costs			ca. 50,500 €/a
Surplus			**ca. 53,500 €/a**

This means that the investment will have a pay-back period of 7 – 8 years at the current cost situation and, above all, **makes the biogas plant sustainably valuable.**

4.2 Optimization version 2 (> **85% degree of degradation**, with enzymatic decomposition)

We are working on this topic since a long time and develop this technology and a user-friendly system concept in order to arrive at an easy-to-use and cost-effective solution.

This decomposition stage will be designed in a way that two-stage biogas plants can be expanded within a little effort to achieve a maximum utilization of the available biomass.

Even with this development, the nature is our model.

INNOVAS Innovative Energie- und Umwelttechnik
Anselm Gleixner und Stefan Reitberger GbR
Margot-Kalinke-Str 9, 80939 Muenchen (Munich), Germany
Fon: +49 89 16 78 39 73   Fax: +49 89 16 78 39 75
E-mail: info@innovas.com
URL: http//www.innovas.com