Groot Zevert Vergisting (Beltrum, NL)

A short introduction to GZV

Groot Zevert Vergisting (GZV), located in Beltrum, The Netherlands, started it's biogas activities in 2004. The fast-growing company is now one the largest anaerobic digestion plants of The Netherlands. Each year, about 10 million m^3 biogas are produced from 135 kton of feed-stock through mesophilic digesation.

In 2019, they started with the production of biobased fertilisers, soil improvers and clean water from digestate. In doing so, they aim to offer a sustainable solution to the manure surplus in their region.

Drivers for Nutrient Recycling

In the Netherlands, manure production by livestock is greater than the amount that can be applied on agricultural soils. Manure application is regulatory limited by both its phosphorus and nitrogen content. Farmers are allowed to apply 170 kg N/ha as manure (or 230-250 kg N/ha on derogation farms) and this is regulated by the Nitrates Directive. On top of that, farmers can apply mineral N fertiliser. The surplus amount of pig manure, about 30% of its total production, is transported to other countries, mostly Germany. The transport of large volumes of manure over distances of 200-400 km is costly. As a consequence, farmers are faced with high costs for manure disposal (€ 20,- per ton pig manure).

As a solution to the manure surplus in the region, GZV decided to invest in nutrient recovery technologies converting digestate into valuable biobased fertilisers:

- Nitrogen potassium (NK) concentrate to be used on grassland and arable fields within the region
- Clean water to be discharged in a nearby stream
- Organic soil improver with a low nutrient content
- P fertiliser to be used as ingredient for the production of mineral fertiliser at ICL Fertilizers.

These biobased fertilisers can be used within the region or can be exported over long distances against low costs. The separation process is therefore expected to generate substantial costs savings.

Feedstock and biogas production

The co-digestion plant treats 100 kton of manure and 35 of co-products (Table 1). Pig manure is collected from about 55 pig farms in the region. About 80% of the biogas is used by a nearby dairy factory of Friesland Campina. which is connected to GZV via a 5 km long pipeline. The other 20% is converted to electricity and used on the digestion plant.

Table 1. Feedstocks of the GZV digester (2018)

Type	Origin	Mass
Manure	Pig manure	80 kt
	Dairy manure	5 kt
	Slaughterhouse manure	15 kt
Co-products	Waste dairy industry	15 kt
	Waste feed industry	15 kt
	Glycerin	5 kt
Total		**135 kt**

Table 2. Biogas production

Component	
CH_4 (%)	58
CO_2 (%)	40
H_2S (ppm)	2000-3000
O_2 (%)	0.2
Total biogas production (Mm^3)	10
Biogas per tonne of feedstock (m^3/t)	75

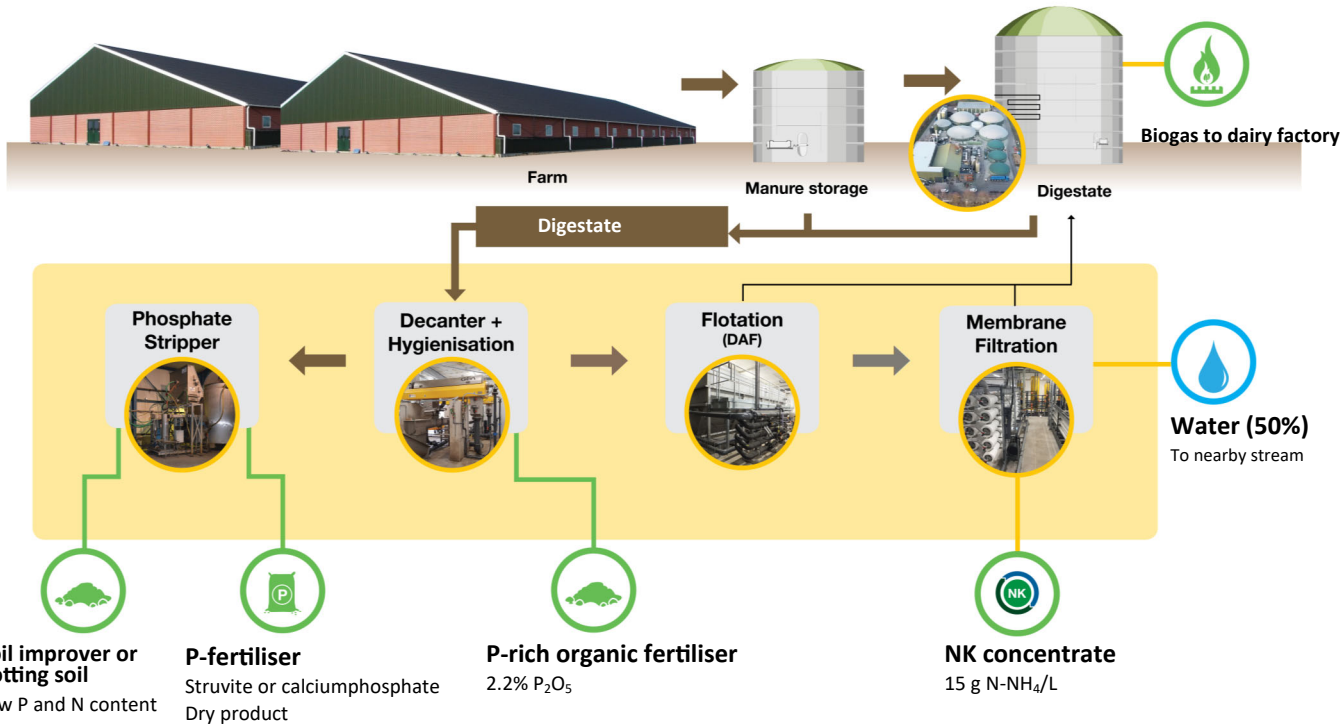
Groot Zevert Vergisting (Beltrum, NL)

The nutrient Nutrient Recovery Technologies

Digestate is separated into a solid and a liquid fraction by a GEA decanter centrifuge. The solid fraction is hygienised by heating it with infrared light. The nutrient recovery treatment process consist of two independent units for treatment of the liquid fraction (GENIUS process) and the solid fraction (RePeat process).

GENIUS technology: From liquid manure to NK concentrates and clean water

In the GENIUS process, the digestate is separated into a solid and a liquid fraction by means of a decanter centrifuge (Figure 4). The N-rich liquid fraction is processed into an NK concentrate and clean water through a combination of dissolved air flotation (DAF) and micro filtration (MF), reverse osmosis (RO) and ion-exchange (IX). The NK concentrate is contains 10-15 g N L^{-1} as NH_4. The water meets the strict quality criteria and can therefore be discharged on a nearby stream.



The NK concentrate is blended with ammonium sulphate and/or ammonia water which are recovered at other nutrient-recovery plants to meet the crop requirements of grass, maize and potato in the Achterhoek region. In 2019, this product will be used by 50 farmers who have signed up to join the 'Biobased Fertilisers Achterhoek' pilot project which allows them to use the blended fertiliser as an alternative for synthetic nitrogen fertiliser. These farmers can apply the blend above the N application standard of manure similar as synthetic N fertiliser.

The pilot project will generate data on the agronomic performance and nitrogen use efficiency (NUE) of the biobased fertilisers applied. These data will serve the current political debate within the EU (SAFEMANURE) about the acceptance of N-fertilising products from manure as alternatives for synthetic fertilisers.

Table 3. Expected product composition (based on pilot tests)

Parameter	Unit	Ingoing digestate	GZV Recovered products			
			NK-fertiliser	Soil Improver	P-fertilizer	Clean water
Mass	(%)	100	20-35	10-15	1-2	50-56
Dry matter	(kg/ton)	72	46	320	800	-
Organic Matter	(kg/ton)	52	18	290	320	-
N	(kg/ton)	6.5	10-15	5.0	20	<6 mg/L
$N\text{-}NH_4$	(kg/ton)	4.6	10-15	<1	-	<2.5 mg/L
P_2O_5	(kg/ton)	3.5	0.2-0.4	3.2	140	<0.6 mg/L
K_2O	(kg/ton)	4	8-20	0.2	5	<400 mg/l

The RePeat process: Separating P and organic matter

In the RePeat process, P will be recovered from the P-rich solid fraction of digestate. The solid fraction is mixed with water and thereafter acidified to pH 5 using sulphuric acid. At this pH, nearly all P dissolves. The dissolved P can be separated from the solid fraction by separation with a screw press. Subsequently, P is recovered from the acid liquid through addition of a base, preferably $Mg(OH)_2$, to form struvite crystals. Apart from $Mg(OH)_2$, also other bases such as $Ca(OH)_2$ may be used though the latter produces an amorphous precipitate which requires an additional separation and drying step. The solid fraction is treated in two sequential leaching steps during which 90% of the P is removed. What remains is an organic soil improver with a very low P content.

Part of the sulphate, added as sulphuric acid, precipitates with calcium as gypsum which is either recovered together with the P-fertiliser or as a separate organic gypsum-rich sludge that can be used as fertiliser. Water is continuously re-used within the process. Hence, creation of an additional waste stream is prevented.

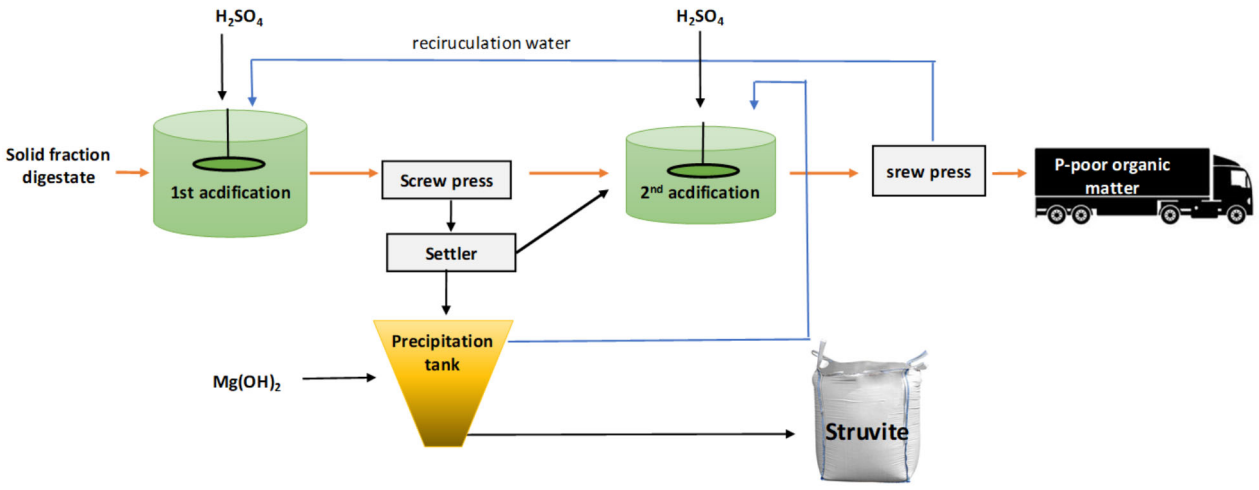


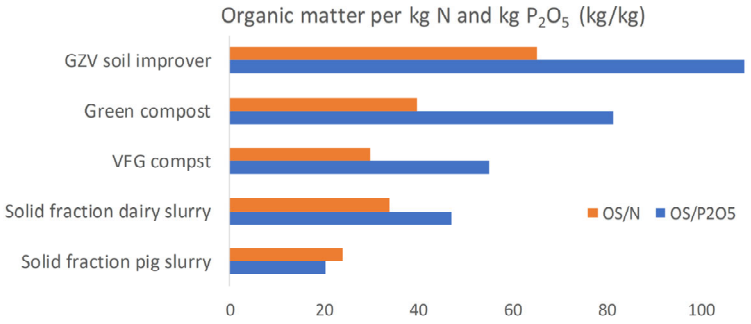
Figure 2. Simplified process scheme of the RePeat process converting solid fraction of manure into P-fertiliser and a soil improver

Groot Zevert Vergisting (Beltrum, NL)

Soil Improver and peat substitute

The demonstration installation at GZV is expected to produce about 35-40 ton of soil improver and about 5 ton of struvite or calciumphoshate per day. The soil improver, consisting for 90% of organic matter, can be used on arable fields in the nearby region of the plant. Because of its low N and P content , farmers can apply a large amount of organic matter within the N and P application limits. The soil improver has a fibrous structure and is therefore a suitable potting soil ingredient. To become a peat substitute, an additional leaching step is needed to reduce the salt content of the organic fibres.

Figure 3. Organic matter to nutrient ratio of GZV soil improver



The recovered struvite or calciumphosphate can be used an ingredient for the production of mineral or organic fertilisers.

The benefits

Groot Zevert aims to realize the following benefits

- Balanced fertilisation with products from manure
- Replacement of synthetic N fertiliser by biobased products
- Recovery of the non-renewable element P in a valuable fertiliser to be used elsewhere
- Over 3000 truck movements to Germany per year are prevented.
- A substantial decrease in CO_2 emissions associated with transport
- Lower manure disposal costs

Outlook

The GENIUS installation has been in operation since 2019. In the next two years, monitoring of the mass balances, chemical consumption rate and energy use will be continued and further experience will be gained with blending of the NK concentrate and its field application.

The RePeat installation will be in use from June 2019 onwards and form that point onwards monitored on a bi-weekly basis. Further research on the use of other bases than $Mg(OH)_2$ is foreseen as well as experiments with a desalted soil improver as peat replacer in potting soil.

Further reading

Website of the H2020 project SYSTEMIC: www.systemicproject.eu , systemic@wur.nl

Website of the “Groene Mineralen Centrale” www.groenemineralencentrale.nl; info@groenemineralencentrale.nl