Factsheet
SYSTEMIC Associated Plant

Arbio BVBA (Arendonk, Belgium)

A short introduction

Arbio BVBA is a biogas plant located in Arendonk, in the province of Antwerp, Belgium. It is currently operated by Tim Keysers, who started the plant with his father-in-law next to the pig farm of Tim's father-in-law in. The region has a manure surplus and a biogas plant could then be a solution to lower this manure pressure to the soil and at the same time produce green energy.

Table 1. Technical information of the biogas plant

Date of construction	2011-2013
Volume digesters (m^3)	16,000
Digester type	thermophilic digestion

Feedstocks

The digesters are fed with 55,000 ton of manure (7000 ton manure from their own farm) and 35,000 ton of food industry waste per year.

Biogas production

The biogas production in 2018 was 105.000 m³. This is converted in a CHP to 22.000 MWh.
14% of the produced electricity is used on site.
The heat from the CHP is used to in a band dryer to dry the solid fraction of the digestate.

Table 2. Origin of feedstock

Type	Mass per year
Manure	55 ktonnes
Food industry waste	35 ktonnes
Total	**90 ktonnes**

Previous configuration of the digestate treatment process

The digestate was separated by means of a decanter centrifuge and addition of flocculants. The solid fraction of the digestate was dried on a band dryer and exported. The liquid fraction was concentrated by evaporation, while cleaning the ammonia rich air with an acid air scrubber, producing ammonium sulphate, which is regarded as an artificial fertiliser in Flanders. The ammonium in the concentrated liquid fraction is afterwards treated in a biological nitrification-denitrification to environmentally harmless N_2-gas.

Drivers for Nutrient Recovery and Reuse (NRR) Technologies and goals

The quantities of ammonium sulphate solution were still quite high and the amount of phosphorus in the effluent made it more difficult to use this on Flemish agricultural land.
Also the composition of the solid fraction (N/P/K ratio) was not really in line with the demand of most crops to make the marketing or disposal of these products economically beneficial.
Most of all, Arbio wanted to make their biogas plant more circular, meaning to make products better adapted for crops in the region, reducing the volume and hereby transport costs and CO_2 emissions and recovering the nitrogen instead of losing it to the air.

Horizon 2020

*The H2020 EU-project SYSTEMIC (**Sy**stemic large **s**cale eco-innova**t**ion to advance circular **e**conomy and **mi**neral re**c**overy from organic waste in Europe) receives funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement no. 730400*

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NPirriK

Arbio developed a novel cascade of existing technologies to solve these problems, called **NPirriK**. They applied in 2017 with success for the Flemish call for subsidies for circular economy projects "Vlaanderen Circulair".
The NPirriK cascade consists of a separation of the digestate with of a belt press with bio-degradable flocculants into a liquid fraction (80%) and a solid fraction (20%).
This solid fraction contains the largest amount of organic matter and phosphorus.

The liquid fraction of the digestate contains the largest share of the nitrogen and salts (mainly potassium) and has a low organic matter content. Itis treated in subsequently a decantation tank and self-cleaning filters, before it is sent to a reverse osmosis unit, which consumes three times less energy than the biological nitrogen removal. The RO produces a nitrogen-rich and salty concentrate and a permeate which is poor in salts and organic matter.
The concentrate would, because of strict nutrient application limits for N and P be difficult to apply on land. But it is now mixed with the phosphorus rich solid fraction before drying it on a belt dryer, resulting in fertiliser pellets with a significantly higher N/P ratio (3 to 4 times higher than if it would not be mixed). This way the fertiliser pellets comply better with the application limits in Flanders and the demand of farmers.
Because the permeate has low salt levels, it can be used as irrigation water for the surrounding arable land.

RO unit

Mixer for concentrate and solid fraction

Table 4. Estimated composition of the recovered products

	Mass (kton/year)	Dry matter (%)	N- total (g/kg)	P-total (g/kg)	K_2O-total (g/kg)
Raw digestate	81		6		6
Solid fraction after belt press	20%	20			
Liquid fraction after belt (cleanest fraction)	60%				
Liquid fraction after belt (fraction after pressing)	20%				
Concentrate after RO	40%	10	10		
Permeate after RO	60%				
Concentrate + solid fraction dried and pelletized "Kempenkorrel"		93	55	28	23,4

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