BOOK OF SUCCESS STORIES

of companies actively adopting recovery technologies

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Table of contents

Introduction

Europe demands critical attention towards the inappropriate management of agricultural nutrients. One of the key steps to ensure the environmental security of the European Union (EU) is to close the nutrient loop and thus warrant the efficient use of agricultural nutrients. The transformation of Europe to a more circular economy can be brought by the recovery and reuse of nutrients from biomass streams like animal manure, sewage sludge and food waste which can contribute greatly towards improving the efficiency of nutrient management. Different nutrient recovery technologies (NRTs) are indispensable to enable the recovery of nutrients from biomass streams and, currently, there are several established NRTs in the market. Each technology, however, deals with its own issues related to implementation and/or operation. Moreover, marketing of the final products (i.e. recycling-derived fertilisers (RDFs)) and their acceptance by end-users are crucial for closing the nutrient loop in EU agriculture.

ReNu2Farm is an Interreg North West Europe (NWE) project that focusses on nutrient recycling and upscaling from pilot level to farms and fields. Its priority specific objective is to optimise the reuse of material and natural resources in NWE. One of the tasks of the project is to provide an overview of the practical experience and testimonials from businesses actively adopting recovery technology. This report focuses on success stories of 10 producers: Green Generation, Enrich Environment (Ireland), Group op de Beeck, Vermeulen Construct (Belgium), GMB and Eraspo (the Netherlands), Violleau, SEDE Environnment, Germiflor (France) and Ökobit (Germany). By sharing their success story, the insights into potential obstacles and solutions of using NRTs are shared with other companies in recycling sector and potential new business in recycling sector of animal manure, sewage sludge and food waste. Initially, each success story begins with a brief history / background of the company formation and their current activities. The stories then move on to succinctly describe the challenges faced by the companies, and possible solutions and its implementation to overcome these barriers. On an ending note, each success story leaves a valuable advice that new businesses in the recycling sector can use as a take-away message.

The consortium of ReNu2Farm project would like to thank owners/managers of interviewed companies for sharing the valuable input.

Green Generation (Ireland)

Success story of **Green Generation**

"To be involved in Ireland's first grid injection anaerobic digestion facility has been extremely rewarding, and I would do it all over again"

Michael McEniry, NRGE

The Company

HISTORY

Green Generation Ltd. is a €5 million Irish company that is located beside a 3000 sow-pig farm in Nurney, County Kildare, Ireland (*Figure 1 and 2*). The company was established to develop a farm-based anaerobic digestion (AD) facility. Construction took place in 2014 and the first electricity was produced in late 2014.

In 2016, Green Generation purchased a site at Cush in County Kildare, for gas injection. Green Generation became part of the pilot project with Gas Networks Ireland for the first grid injection site in Ireland. The final commissioning, with gas flowing to the grid, took place in February 2020.

Figure 2: Managing Director Billy Costello.

Figure 1: Green Generation plant in Nurney, County Kildare.

CURRENT BUSINESS

Green Generation's biogas plant is licensed to process 48 000 tonnes of biomass, consisting of pig manure, food processing waste and waste food. The Nurney plant has two primary digesters which are 2 000m^3 each and a 4 000m^3 secondary digester. The anaerobic digester can produce up to 300m^3 of methane/h to produce electricity and 1.2MW of heat. This biogas is the fuel source in the combined heat and power (CHP) unit. The surplus biogas is pre-cleaned using a unique technology to Green Generation, which involves pre-scrubbing the gas with tyre rubber. Following this stage, gas scrubbing and cleaning with carbon filtration takes place.

The gas is compressed in a specific three-stage gas compressor. The compressed biogas is transported 12 km on the Regional Road Network from the production site in Nurney to the natural gas grid injection site in Cush via a virtual pipeline. Each month, Green Generation is capable of generating enough biomethane to power 500 homes. The heat produced in the CHP is used for pasteurising the digestate and heating the pig unit. The AD by-product, digestate, is high in mineral nutrients nitrogen, phosphorous and potassium. Digestate can be spread as high-quality eco fertiliser on local farmland.

The Challenge

TEMPERATURE

Initially, it was intended that the primary digester would operate as a thermophilic digester functioning between 53-55°C. However, in this case, this system proved to be too unstable.

PIPING GAS TO INJECTION FACILITY

It was originally planned to have a 6 km pipeline from the Nurney site to the Cush site. However, this involved crossing a river, a special area of conservation and a railway line causing potential problems from a regulatory point of view.

FIRST IN IRELAND

Green Generation is the first company in Ireland that have been successful in the grid injection process. Therefore, this pilot project 'Gas to Grid', proved to be a steep learning curve for both, the supplier Green Generation and the regulator Gas Networks Ireland.

GREEN Generation
NRGE
Interreg North-West Europe ReNu2Farm
European Regional Development Fund

Success story of **Green Generation**

"To be involved in Ireland's first grid injection anaerobic digestion facility has been extremely rewarding, and I would do it all over again"

Michael McEniry, NRGE

The Solution

REDUCE TEMPERATURE

The primary digester was changed to a mesophilic process which functions at a cooler temperature range of 35-37°C. Although this has a longer retention time than thermophilic digesters, it is a more stable system from an operational viewpoint.

VIRTUAL PIPLINE

To overcome the obstacles of laying a pipe to transport the biogas from the production site to the gas injection site, a virtual pipeline was established. This virtual pipeline involves loading the gas onto a gas trailer and transporting it 12 km on the road via a truck and trailer system.

FIRST IN IRELAND - TEAMWORK

Teamwork is important between the supplier Green Generation and the regulator Gas Networks Ireland as they both try to navigate the course to establish a productive company that can achieve its output goals. Respect must be given to both sides, and the size of the supplier must be recognised.

The Implementation

As this was the first grid injection plant in Ireland, the implementation process took longer than expected.

The virtual pipeline is working well (*see Figure 3*) and was the correct decision for this particular site. By using a virtual pipeline, the company avoided a lot the regulatory issues which would have added a significant amount of time to the project.

The modular grid entry unit (*see Figure 4*) is operating well. This unit monitors the gas quality and meters the quantity of gas entering the grid.

It was great to be involved in this project and Green Generation is happy with the end result.

Figure 3: Biogas transporting trailer with filling station on the Nurney site.

Figure 4: The modular grid entry unit and the gas quality monitoring and metering of biomethane unit at the Cush site.

The Advice

A more streamlined approach through the regulators, the connected system's agreement, and through the operation connected systems agreement is required to make this process easier, quicker and more efficient.

Good communication and teamwork are important to navigate this process, to establish the development in a timely manner and ultimately to achieve our goal of a 'Gas to Grid' connection.

In the end, "I would do it all again."

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Enrich Environmental (Ireland)

Success story of **Enrich Environmental**

"Taking material that would have ended up going to landfill and manufacturing it into a high quality product has been our ethos"

Kevin McCabe,
Enrich Environmental Ltd.

The Company

HISTORY

Enrich Environmental Ltd. (Enrich) is located in Co. Meath and is the largest producer of peat free compost in Ireland *(Figure 1)*. The composting facility was established in 2004 and since then Enrich has composted over 100 000 tonnes of green garden material. It is an award-winning company that produces a range of composts, compost enriched top-soils, bark and specialist soil blends.

Enrich was one of the first companies in Ireland to be accredited under the Compost Quality Assurance Scheme IS441. The company produces compost which is a multifunctional soil improver and displaces the use of peat and artificial fertilisers. These natural products are sustainable, cost-effective and feed into closed-loop recycling which is central to the company's product development and ethos.

Figure 1: Enrich facility, Kilcock, County Meath, Ireland.

CURRENT BUSINESS

Enrich operate a variety of composting processes. Open windrow composting, where green material received from landscaping contractors or local authority centres is shredded and processed outdoors in long rows for 12-16 weeks *(Figure 2)*. In-vessel composting, where food waste and other difficult organic fractions are composted and stabilized in larger scale closed vessels. Forced aeration composting where green material and agricultural wastes are processed into nutrient dense compost. Temperature, pressure, airflow, moisture, and oxygen levels are some of the key parameters which are monitored and controlled throughout. The compost is then sorted *(Figure 3)*, screened *(Figure 4)* and utilised as the key component for added value substrates or sold in bulk as compost.

Figure 2: Open windrow facility at the Enrich composting site.

The Challenge

CERTIFICATION

Enrich's green compost was one of the first composts in Ireland to be awarded the Organic Product Certification by the Irish Organic Association. The compost also complies with the National Standards Association of Ireland. The composting industry in Ireland is quite small and Enrich is at the forefront of certification, always aiming to produce high quality compost and soil products.

MARKETING

True compost must have undergone an aerobic degradation process. Enrich compost is alive with beneficial microbes which support plants by making nutrients available and producing humus. Enrich's composting processes are controlled to eliminate pathogens and weed seeds. Enrich compost also contains all the essential macro and micronutrients as well as organic matter to improve soil fertility, structure and drainage.

NICHE AREA

Enrich have found their niche as compost specialists. Enrich design, develop, and operate processing sites, produce products, develop markets, and provide scientific based soil, waste, and environmental solutions. This unique, unrivalled, and holistic offering has led to Enrich being awarded site management and development contracts even in other countries, such as the United Arab Emirates.

enrich
IRISH NATIONAL COMPOST QUALITY ASSURANCE SCHEME CQAS 441 CERTIFIED
IRISH ORGANIC ASSOCIATION IOA Certified Product Scheme
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European Regional Development Fund
EUROPEAN UNION

Success story of **Enrich Environmental**

"Very simply, if you improve your organic matter you improve your whole soil structure."

Kevin McCabe,
Enrich Environmental Ltd.

The Solution

PRODUCT DEVELOPMENT

Enrich are always striving to better understand their product through market research and scientific research and development, such as the characterization of the microbiome of Enrich Compost, how the compost performs in temperate and arid environments and routine material testing. Ultimately, research and development, product development and new service offerings are driven by customer desire.

AWARENESS

Informing people and increasing their environmental awareness is a challenge, not only in Ireland but throughout the world. It is important to inform the customer that compost is a recycled product and it is better from a sustainability point of view. Enrich focus on informing Ireland's future generations through community-based work, schools visits and participation and support for national and international conferences and workshops such as the Young Environmentalist Awards.

SPECIALIZED MARKET

The Organic Certification allowed Enrich to enter into a specialised and specific market. Through this niche market, Enrich are opening up availability of organic compost to farmers, as currently there are only 3-4 organic certified producers in Ireland. Enrich also specialises in providing soil solutions to the landscaping and construction sector, through the development and manufacturing of soil blends such as lightweight soils for green roof applications (SuDS) and urban tree soils. All products utilise sustainable Enrich Compost.

The Implementation

Enrich started with compost and now have developed 27 different products that are all based on recycling organic waste.

Their first product was compost that could be dug into farmland. Now they produce soils that are suitable for wildflower or biodiversity roofs, as they retain rainwater.

They also produce structural soils for urban tree planting. All these products stem from recycled material and the compost forms the basis of all these products.

Figure 3: Sorting compost on the Enrich site.

Figure 4: Fine screening compost on-site.

The Advice

At a business start-up stage, it is important to identify gaps in the market to develop a niche for the company and to specialise your product.

What are customers' problems, and can you provide solutions? It is also prudent to set your starting goals based on the highest quality standards available for your intended products and services.

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Group op de Beeck (Belgium)

Success story of **Group Op de Beeck Materials & Treatment**

"Your waste, our energy"

Slogan of the Group op de Beeck

The Company

HISTORY

What started more than 25 years ago with one truck driving around for a shop selling animal feed and fertilisers, gradually expanded by selling organic by-products such as those from the potato processing industry, mushroom compost, pine bark, etc. The group continued to expand its activities and expertise in organic side streams and waste streams and evolved into a group with treatment facilities on different locations.

One division, located at the port of Antwerp (Kallo site, *Figure 1*), comprises 3 major activities: organic fertiliser production through biothermic drying of manure, the processing of organic waste streams followed by green energy production and nutrient recovery. The process of organic waste processing and nutrient recovery is currently a unique showcase of green energy production and nutrient recycling.

Figure 1: Op De Beeck Materials & Treatment facility in Kallo.

CURRENT BUSINESS

Group Op de Beeck offers their clients a reliable partnership to find sustainable and competitive solutions to convert their organic by-products and waste streams into high-quality raw materials. The company guarantees an extensive quality control and compliance with Flemish, Belgian and European legislation.

The plant in Kallo processes up to 350 000 tonnes y^{-1} of organic waste streams via anaerobic digestion (AD), which generates green energy and heat. The heat and part of the electricity (approx. 20-25%) is used during the subsequent processing that leads to a full recovery of the nutrients from the digestate. The resulting biogas is valorised in 6 Combined Heat and Power (CHP) units with a total electrical output of 8.6 MW, resulting in a yearly production of 74 500 MWh green electricity, sufficient for approximately 23 000 Flemish households. Moreover, the plant produces annually about 150 000 tonnes of stable and homogeneous organic fertilisers. Finally, the advanced processing of the liquid fraction (LF) of digestate, i.e. the end-product of AD process after mechanical separation, results in about 25 000 tonnes y^{-1} nutrient-rich concentrate and about 2 000 - 3 000 tonnes y^{-1} ammonia (NH_3) water.

The Challenge

The high average water content of the processed organic waste streams (e.g. rejected food from supermarkets, residues from food processing, water purification sludges, …) results in a considerable volume of digestate (dry matter (DM): 8-10%, *Figure 2*).

As a first step, centrifugation and fluidised bed drying (only using electricity and heat from its own CHPs) generates a solid and valuable organic soil improver, rich in phosphorus (P).

The remaining LF contains the majority of the nitrogen (N) and potassium (K). However, the commercialisation of the LF as a fertiliser is difficult due to the low DM content and low nutrient concentrations in the product. This demands higher application rates, leading to increased transportation costs. This challenge stimulated Group Op de Beeck to look for a technology that allowed an efficient up-concentration of the nutrients and a significant reduction in the water content.

Additionally, Group Op de Beeck also wanted to choose a nutrient recovery technology (NRT) that enabled them to become fully integrated and that yielded highly valuable products.

Figure 2: By-product with low dry matter

GROUP OP DE BEECK

Interreg North-West Europe ReNu2Farm

European Regional Development Fund

Success story of **Group Op de Beeck Materials & Treatment**

"Your waste, our energy"

Slogan of the Group op de Beeck

The Solution

In line with the Flemish and European policies towards a circular economy, Group Op de Beeck considered evaporation or filtration as a suitable NRT, since both are proven NRTs for N-rich fluids. With the on-site production of green energy (heat and electricity), and the potential disadvantages of filtration (membrane fouling), the choice of an evaporator was obvious (*Figure 3*).

The LF of digestate, after centrifugation, is fed into the evaporator, resulting in a P and K-rich concentrate and an NH_3-rich condensate. The condensate downstream is processed in an NH_3 stripper, which produces NH_3 water (approx. 20-22 %) and purified water. The purified water is either reused on site (process water, cleaning trucks, machinery, etc.) or surpluses are discharged in surface water, as it meets the Flemish legal discharge limits. Thus, the processing through evaporation results in 3 products (*Figure 4*): i) a PK-rich concentrate, that after addition of NH_3 water, if requested by an end-user, is sold as a liquid organic fertiliser; ii) NH_3 water, that can substitute fossil urea in industrial DeNOx installations (i.e. incineration plants); iii) purified water, that is mainly reused on site.

Figure 3: Evaporators at Kallo location of Group op de Beeck.

The Implementation

All subsequent processes during the implementation of the new technology have to be in line with each other, since a small change in upstream can have a substantial impact downstream. This co-ordination requires a non-stop monitoring and a robust technology.

Despite all the governmental incentives and policies to realise the transition towards a circular economy, both market and policy makers continue to lack confidence in recycled products.

In Flanders, the reuse of recycled products as raw materials is regulated by the Vlarema legislation that sets a restricted list and requirements related to composition and use. For new products and applications such as the recycled NH_3 water, it was, and still is difficult to convince policy makers that this is a valuable and sustainable substitute for the fossil urea currently used in DeNOx installations.

Therefore, it took a substantial amount of time to elaborate all aspects of the project (technological, legal, financial, …). However, after a successful testing period, the NH_3 water is now used as a DeNOx reactant by multiple customers.

Figure 4: Raw digestate, solid fraction of digestate, liquid fraction of digestate, PK- rich concentrate, NH3 water and condensate produced by Group op de Beeck

The Advice

Group Op de Beeck Materials & Treatment advises other companies to build up their treatment facilities step by step. The variations in the composition and quality of the input waste streams present quite a challenge for the process control. So it is important to fully control one process step before implementing an additional one. Each process generates new end- and by-products and has its specific technological, practical and legal issues to tackle.

GROUP OP DE BEECK

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Vermeulen Construct (Belgium)

Success story of
Vermeulen Construct NV

"Quality tailored to the farmer"

Geert Vermeulen,
Vermeulen Construct NV

The Company

HISTORY

Vermeulen Construct NV started about 30 years ago as a company specialised in tailored construction of feed systems and ventilation techniques in pig farming. Later on, the company incorporated the activities specialised in leek processing machinery.

Nowadays Vermeulen Construct NV ensures a perfect finish of an animal stable in terms of electricity, ventilation, air purification, feeding systems and manure separation. The company is a developer (along with Beton Dobbelaere) and distributor of the unique Vermeulen Dobbelaere Welfare System (VeDoWS) stabling system for manure separation (*Figure 1*).

CURRENT BUSINESS

Today, the company can be categorised as a Small and Medium-sized Enterprise (SME) with a turnover of 3 million EUR and 11 full-time equivalents. It is located in an agricultural region in the southwestern part of Flanders. It offers the following products: stable equipment, customised metal construction and leek processing machinery, along with VeDoWs stabling system for manure separation that is source-oriented.

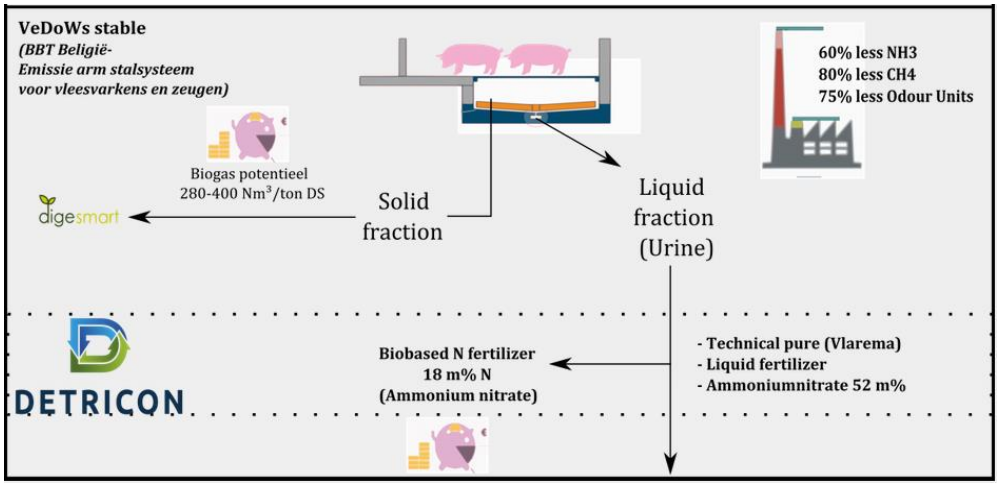

Figure 1: Schematic representation of the VeDoWS stabling system.

The Challenge

Flanders is a densely populated region. The lack of open space led to an intensification of agriculture and explains the high concentration of intensive livestock farms.

In order to mitigate the environmental pressure caused by these activities, farming is subject to strict regulations regarding manure spread and has to implement ammonia (NH_3) emission reduction measures.

While manure processing and NH_3 stripping are end-of-pipe solutions, Vermeulen developed a source-oriented approach.

Whereas separation at the source is a common practice and legally anchored for waste, this principle is not yet a common practice for manure. By separating urine from solid manure at the source, a more efficient nutrient recovery as well as clear benefits for the quality of the air in the stable can be realised.

a) b) c)

Figure 2: The VeDoWS system for manure separation: a) pipeline which collects urine from all the stable units; b) conveyor belt to transfer the SF from the slatted floor to the manure storage area; c) gutter for urine collection

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Success story of
Vermeulen Construct NV

"Quality tailored to the farmer"

Geert Vermeulen,
Vermeulen Construct NV

The Solution

VeDoWS stable system for primary manure separation ensures efficient separation of animal excreta and urine at the source, aiming to counteract the formation of urease, and the subsequent emission of NH_3 which is harmful to both humans and animals.

Underneath the slatted floor, there is a concrete floor with a slight slope and a central gutter. By gravitation, the urine fraction is collected in the gutter. It is a highly demanded N and K fertiliser.

A scraper system removes the solid manure regularly (*Figure 2*). The solid manure is transported weekly to an anaerobic digester. Thanks to the early separation, chemical reactions between solid and liquid fraction are avoided, yielding multiple benefits:

i. Overall emission reduction of NH_3, methane (CH_4), hydrogen sulphide (H_2S), nitrous oxide (N_2O). This leads to a considerable improvement of the stable climate and the odour nuisance, and a reduction in the costs required for NH_3 stripping. As a consequence, energy and water usage are reduced, which has both economic, operational and environmental advantages. NH_3 reduction up to 70% can be realised.

ii. The dry fraction of the manure yields 350 Nm^3 $tonnes^{-1}$ biogas with a 65% CH_4 content, thus improving both quantity and quality of the produced biogas compared to unseparated manure.

iii. A climate-friendly stable system: lower CH_4 emissions at the source and a dry fraction with a high biogas potential.

The Implementation

All new stables have to be constructed according to legally established low-emission standards for NH_3. By ministerial decree, the VeDoWS system is included in the list of licensed low-emission stabling systems (*Figure 3*), both for fattening pigs and for sows. It thus offers an innovative, sustainable and certified stable system that is cost-effective for farms from minimum 1000 pigs onwards.

Before being approved as a low-emission system, the VeDoWS system was subject to an extensive quality control: the emissions of a test stable with VeDoWS system were continuously monitored during a full year. Test results were then evaluated by a scientific committee that advised the Flemish ministry. This procedure is challenging since, on one hand, the building of a test stable entails a considerable investment while, on the other, there was no publicly available assessment framework. Later, Flanders decided to subscribe to the VERA testing protocol. Although this creates a framework, the protocol also makes testing more challenging and economically unfeasible for SMEs, since a certification now requires multiple testing facilities, thus even higher investments.

Figure 3: Installed VeDoWS system at an animal stable.

The Advice

The investment in a stable system is a long-term investment decision. Transparency regarding legal and environmental framework is essential to incentivise farmers for sustainable investments instead of end-of-pipe modules. Clear policies such as an established roadmap for nutrient transition with clear goals would incentivise farmers to invest in a sustainable stable system and thus facilitate the nutrient transition. A transparent and co-operative relationship between companies and government thrives implementation of innovations.

Construct Vermeulen
GREGOIRE BESSON

Interreg
North-West Europe
ReNu2Farm

GMB BioEnergie (the Netherlands)

Success story of **GMB BioEnergie**

"Sewage sludge is a challenging resource to work with…"

Martin Wilschut,
GMB Bioenergie

The Company

HISTORY

The history of sewage sludge treatment by GMB BioEnergie goes back to 1988. As early as in 1991, a first test tunnel for composting with cleaning of the process air and computer controlling (technology of mushroom cultivation) was set up.

In 1998, there were already 20 tunnels on two locations in operation. The ammonium washer technology was introduced in 2001.

Today, 41 tunnels and 2 ammonium washer installations at 2 locations are in use, treating 20 % of the total sewage sludge of the Netherlands: 260 000 tonnes of sewage sludge and 200 000 tonnes of (fluid) industrial sludge (dairy and potato industry) every year (*Figure 1*).

CURRENT BUSINESS

The solid fraction (SF) of sewage sludge after anaerobic digestion and mechanical separation is composted. The SF is composted in tunnels where the air is washed with sulphuric acid to obtain ammonium sulphate ($(NH_4)_2SO_4$), a liquid fertiliser used in agriculture. On yearly basis, 18 000 tonnes of $(NH_4)_2SO_4$ (neutral pH, 8% N, 22% SO_3 and 38% dry matter) are produced, and mainly sold to contract workers who distribute for farmers. Since 2005, $(NH_4)_2SO_4$ has the official license to be marketed as a fertiliser. Currently, it is sold in the Netherlands and in Germany.

The composted SF is sold as biofuel for green energy and as a soil improver. As a fuel material for energy production (Rotterdam harbor and energy centrals in NL and DE), around 115 000 m^3 of biofuel granules are produced on annual basis. Since 2019, the biogranules are also marketed as a soil improver under the brand name "TradiPhos" for agriculture in France.

Figure 1: Aerial view of GMB BioEnergie.

The Challenge

GMB is paid by sewage treatment plants to carry out environmentally friendly valorisation of sewage sludge. Nutrient and organic matter recycling has become more and more important in this context since the EU is thriving towards a more Circular Economy.

Formerly, GMB was not recovering nitrogen (N) evolving during the composting process and since the SF was entirely sold as a biofuel granulate, the carbon (C) was also lost during incineration. GMB installed acid air washer as a recovery technology (*Figure 2*) and developed markets to meet the challenge of more nutrient recycling.

The Dutch market for sewage sludge compost applied to land as a soil improver is very limited to non-existent because of the strong concurrence of animal manure as an organic fertiliser. Also, high contents of heavy metals, strict legislation and fear of pollution by farmers do not allow sewage sludge to be returned to soils. That is the reason why until recently the entire compost of GMB was not recycled to agriculture but used as a fuel material for energy production.

Figure 2: Acid air washer for Ammonium sulphate production.

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Success story of **GMB BioEnergie**

"Sewage sludge is a challenging resource to work with…"

Martin Wilschut,
GMB Bioenergie

The Solution

GMB put in place two solutions to recycle more nutrients from sewage sludge: (1) an acid air washer which captures the N as an $(NH_4)_2SO_4$ fertiliser and (2) GMB established a partnership with a sewage sludge treatment plant in France to develop a value chain to sell biogranules as a soil improver in France.

Investing in the $(NH_4)_2SO_4$ recovery technology was in the first place motivated by obligations to reduce the odour evolving from the composting facility.

Nowadays, a complex system of biofilters, a cooler, the acid air washer, a high chimney and soon a bleach leach washer, assure that there are no harmful emissions to the environment and no bad odour bothering the neighbourhood. At the same time, $(NH_4)_2SO_4$ is produced which can be sold as a fertiliser.

GMB together with their partner SEDE Environnment from France succeeded to have all legal permissions to sell biogranulate as a soil improver in France. It helped to have a local partner who managed the administrative process in their country.

What is still pending is the recognition of an end-of-waste status in the Netherlands to facilitate the transport to France.

GMB monitors the sludge quality intensively, both on the input and the output side. Since GMB is operating on two different sites, a division between more strictly monitored sludge composting with selected origin at one of them is possible. For the future, a volume of 25 000 tonnes of soil improver is envisaged.

The Implementation

The technology of the acid air washer was originally inspired by washers from pig stables. GMB upscaled it over the years to fit with the gas composition in composting tunnels.

Concerning $(NH_4)_2SO_4$ as a fertiliser product, GMB considered producing granules out of the liquid since this is what farmers are currently most familiar with and equipped for. However, the technology turned out to be too expensive and it was technically difficult to produce small granules.

Instead, GMB is focusing on guaranteeing a stable N content and a high concentration. The $(NH_4)_2SO_4$ is also neutralised which makes it less corrosive.

GMB also had to invest into storage bag tanks since 60 % of the yearly $(NH_4)_2SO_4$ production is consumed over a few spring months (*Figure 3*). From July onwards, GMB or partners must store the $(NH_4)_2SO_4$.

Figure 3: Storage bag tanks for Ammonium sulphate.

The Advice

Sewage sludge is a challenging resource to work with and it entails a lot of scepticism. As a company involved in sewage sludge treatment, you need to be equipped to face this cynicism. Sewage sludge contains heavy metals and pathogens. However, with the right treatment technology it is possible to limit these risks. As GMB, we advise to carry out careful analyses of the incoming sludge and division in safe badges for nutrient recovery and unsafe badges for biofuel.

GMB

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EUROPEAN UNION

Eraspo (the Netherlands)

Success story of **Eraspo**

"We, the Eraspo team, are proud to contribute to circular farming in Northwest Europe…"

Gera Swinkels, Eraspo

The Company

HISTORY

Eraspo is a family business settled on two locations in Brabant, the Southeastern province of the Netherlands (*Figure 1*). It was started in 1957 by the grandparents of the current owners Gera, Frank, Frans, and Susan Swinkels. In the beginning, the main business was turf processing.

Nowadays, Eraspo's core business is composting of animal manure to produce a soil improver that is adapted to the client's needs. Next to it, Eraspo is also trading other materials such as peat, bio-waste, and ornamental garden compost, spent mushroom compost, and woodchips. At the 2nd location, Eraspo is running a shop for private gardeners and landscapers selling the soil improvers directly in bagged or small volume quantities as well as other landscaping material, including decoration.

The Challenge

At the beginning of the family business, the main activity was to produce turf-based soil improvers and fuel material. However, the demand for this type of material decreased over time whereas livestock production in the Netherlands was intensified and awareness for a manure oversupply rose. This situation created a new market where Eraspo became active to upgrade Dutch animal manure to a product that can be exported.

CURRENT BUSINESS

The main input material of the Eraspo's soil improvers is a chicken manure and pre-separated solid fraction of pig slurry which are composted, and if wished by the client, blended with potassium and magnesium.

Eraspo has their own trucks to transport the manure from farms of the region to their facility as well as to transport the soil improver product to France, which is their main uptake market (*Figure 2*). Eraspo also has all legal certificates which allows them, after cleaning the trucks in France, to transport cereal grains for livestock feed back to the Netherlands. In this way, Eraspo is contributing to circular farming for a long time. Besides France, the soil improver is also exported to countries in Eastern Europe as well as to Asia.

Currently, 45 000 tonnes of animal manure are treated annually. About two thirds of this is chicken manure. For the future, an upscaling of production is in preparation.

Figure 1: Aerial view of Eraspo site.

The main challenge for Eraspo is to constantly adapt to market demands and legislative requirements. Eraspo needs to find solutions to be able to offer tailor-made products, increasing the quality of the products and to adapt to increasing hygienic concerns. The quality objectives are high organic matter content, homogenous product, and easy spreadability on land.

Figure 2: Trucks of Eraspo unloading composted animal manure in France.

ERASPO bv

Interreg North-West Europe ReNu2Farm

European Regional Development Fund

Success story of **Eraspo**

"We, the Eraspo team, are proud to contribute to circular farming in Northwest Europe…"

Gera Swinkels, Eraspo

The Solution

Since 1977, Eraspo has been composting animal manure (*Figure 3*). This has several advantages compared to just exporting the raw manure.

The natural heating of the manure to at least 70 ° C during the composting process creates a safe and hygienic product that fulfills the requirements of EU export regulations. The composting process also reduces the volume of the product which reduces transport costs for the same amount of nutrients and carbon.

Moreover, the quality of the soil improver is enhanced since the carbon is stabilised and is thus more valuable for nourishing the soil organic matter.

Eraspo also invested in mixing and blending technology to upgrade the compost with other minerals (potassium and magnesium) in order to respond to the wishes of clients in terms of nutrient composition.

Figure 3: Composted animal manure of Eraspo (from left to right: GreenGold, GreenLand and GreenPig.

The Implementation

In the implementation process, it was a big challenge to get permission for constructing and extending the buildings of the facility to have enough space for storing the raw manure, carrying out the composting process, and storing the final product (*Figure 4*).

Due to a strict construction policy and fear for leaching and odor impact from the facility, it was a very long process that required a lot of time and money for obtaining numerous expert opinion reports.

To optimise the technical details of the composting process, the Eraspo team went through several years of trial and error to understand how to adapt to the fluctuating input material quality.

Figure 4: Composting tunnel facility at Eraspo.

The Advice

Composted manure makes an excellent soil improver. If you are aware of this value for a good and improved soil quality, this will give you a lot of drive and motivation.

The Eraspo team is proud to contribute to circular farming in Northwest Europe and this gives them the impetus to have perseverance and patience for retrieving all necessary legal permissions for the business."

ERASPO bv

Interreg North-West Europe ReNu2Farm

European Regional Development Fund

Violleau (France)

Success story of **Violleau**

"We aim for the fertilisation at the service of sustainable development"

Dominique Billard,
chief executive of Violleau

The Company

HISTORY

Violleau specialises in the production of organic and organo-mineral soil amendments and fertilisers. The company was founded in 1989 in Forêt-sur-Sèvre (New Aquitania region) before being bought in 1994 by the Marolleau group. At that time, its main activity was based on the collection and recovery of farm effluents for the production of compost.

In 2010, the company joined the Akiolis group, a major European player in the processing of agricultural and agri-food by-products. This marked the beginning of a new phase of development for Violleau, with an expansion of its activities and geographical reach. In 2013, the company inaugurated a new pellet manufacturing unit to complement its historic composting activity.

Today, its expertise in sourcing and formulation has earned it recognition as a reliable player among experts in organic fertilisation and agricultural production.

CURRENT BUSINESS

Violleau's expertise covers all flows, from upstream to downstream: selection and collection of raw materials from recycling (mainly animal by-products, but also agricultural and industrial green waste), production of compost and pellets, transportation and delivery to client cooperatives and businesses *(Figure 1).*

The company is recognised for the quality of its organic fertilisers and soil improvers that can be used in organic farming. It has 2 production units that enable it to produce annually 40 000 tonnes of pellets and 30 000 tonnes of compost, which are marketed throughout France and for export.

Violleau is heavily invested in the development of sustainable agriculture and the circular economy. In addition to recycling organic by-products, it takes care to limit the environmental impact of its manufacturing processes. It also provides its clients with personalised advice according to each soil situation, climate and species for a reasoned fertilisation as close as possible to the needs of their crops.

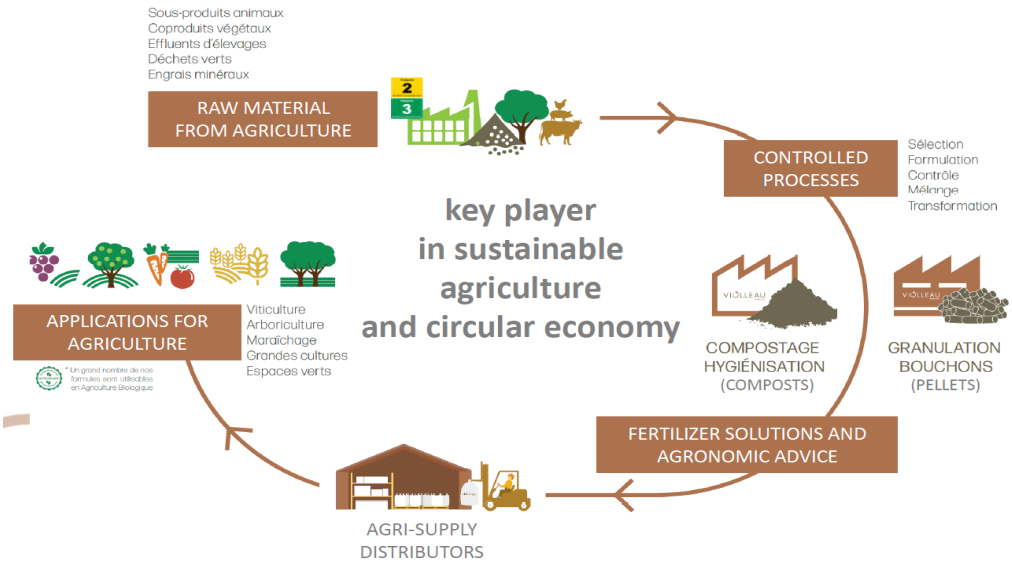

Figure 1: Violleau's involvement in the circular economy

The Challenge

TO MEET THE DEMAND FOR FERTILISATION PRODUCTS ADAPTED TO ORGANIC AND SUSTAINABLE AGRICULTURE

While the demand for organic farming products continues to grow in France and other parts of Europe, farmers should be helped to increase their crop production by providing them with fertiliser products that are the most effective and best suited to their needs. Feeding the soil to nourish the plant is one of the key principles of organic farming. For this production system, soils are fertilised using organic fertilisers in addition to endogenous inputs to the plot. It is also fundamental to contribute to the preservation of ecosystems and ensure that nutrient losses through leaching and volatilisation are reduced as much as possible by ensuring a sufficient rate of mineralisation, as close as possible to the needs of the plants. The challenge Violleau has been facing is to provide solutions for farmers in organic production mode that take all these aspects into account.

VIOLLEAU
AKIOLIS GROUP

Interreg
North-West Europe
ReNu2Farm
European Regional Development Fund

Success story of **Violleau**

"We aim for the fertilisation at the service of sustainable development"

Dominique Billard,
chief executive of Violleau

The Solution

To ensure the development of organic fertilisers and soil amendments that are agronomically efficient, environmentally friendly and adapted to the needs of farmers, Violleau has set up with several independent organisations' evaluations for the effectiveness of its solutions. In particular, the evaluation of nitrogen (N) mineralisation kinetics by using the AZOPRO methodology.

The Implementation

THE STUDY RESULTS

The study showed that PAPs (Category 3 Processed Animal Proteins, made from by-products from healthy animals intended for human consumption) and meat powders (Category 2, made from materials with no proven risk to humans) are rich in organic N and easily assimilated phosphorus. They have therefore been incorporated into some of the company's organic fertiliser and soil amendments formulations, and they can also be used on their own.

As illustrated in *Figure 2*, the carbon in Violleau's products is largely mineralised, which underlines their high biodegradability: they release rapidly mineral elements, including N, which becomes available to crops.

PRODUCT TESTING

The AZOPRO database presents the technical references, acquired by the CTIFL (French technical joint trade Centre for fruit and vegetables) on the composition and behaviour of 60 organic products of soil amendments and organic fertiliser. First of all, a definition is given and the products are divided into two classes: soil improvers and organic fertilisers.

The products are then described in sheets. Each sheet provides, for a given product: i) the chemical characteristics, ii) the results of biochemical fractionation, iii) the potential mineralisation of N and iv) carbon (C) mineralisation.

This database provides users with basic knowledge on the nutritional or amending value of products and their mineralisation/organisation dynamics.

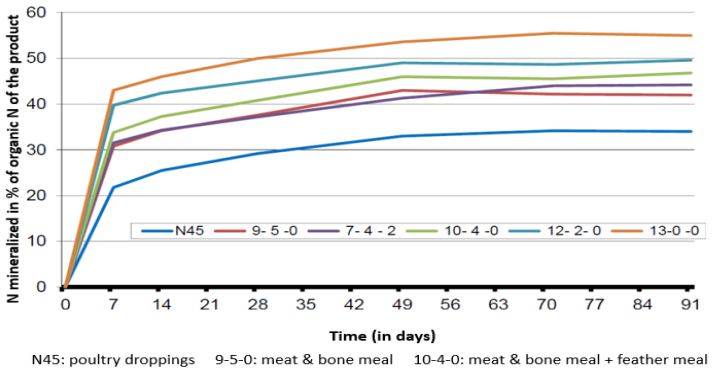

Figure 2: Study of the mineralisation kinetics of 6 Violleau organic products in the laboratory

THE PAP PRODUCTION PROCESS

PAP Category 2 and 3 are meat powders obtained through a pressurised thermal process guaranteeing their bacteriological and viral safety, in application of Regulation (EC) No 1069/2009 *(Figure 3).*

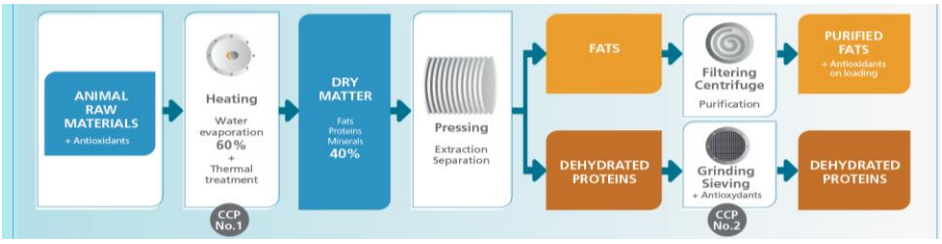

Figure 3: The PAP production process

The Advice

One solution for farmers in organic production is to take advice from specialists in organic fertilisation. Together, they will be able to build an adapted fertilisation strategy that aims to provide, according to the type of soil, the crop, the stage of application, the optimised dose of nutrients, in the most appropriate form and under the best conditions of application. Therefore, the key is in creating connection with your customers.

VIOLLEAU
AKIOLIS GROUP

Interreg
North-West Europe
ReNu2Farm
European Regional Development Fund

SEDE Environnment (France)

Success story of **SEDE Environnement**

"Our goal: to enhance organic matter, to fertilise soils"

Jacques Le Stum,
SEDE Environnement

The Company

HISTORY

With 40 years of experience, SEDE Environnement is one of the forerunners in the agronomic valorisation of waste. The company focuses its activity on the study, design and implementation of recycling sectors, valorisation of industrial and urban co-products as agricultural fertilisers.

In 2000, SEDE created its first compost Platform 'Artois Compost' in the North of France (*Figure 1*). In 2002, the company obtained the first Service Certification 'recycled fertiliser materials' delivered in France. Nowadays, SEDE is a recognised specialist in organic fertilisation and a major player in the production and marketing of fertiliser materials in France.

CURRENT BUSINESS

Today, with its cross-sector offer, SEDE is able to propose solutions for the recovery of all types of organic and mineral waste, through composting, methanation or dehydration process.

Figure 1: Artois Compost at Artois Methanisation site (Pas-de-Calais, France)

The organic raw materials (sludge, green waste, bio-waste) of urban or industrial origin, treated and processed on 35 sites across France and Belgium, are transformed in fertilisers. These fertilisers meet the requirements of French regulations, giving them the same status that is given to fertilisers from the chemical industry and/or mining. Their use is a part of sustainable agriculture, focused on saving non-renewable resources by promoting recycling and enhancing the value of local resources in the context of the circular economy. The produced fertilisers are essentially organic products that have a dual action: crops nutrition and maintenance of soil fertility.

SEDE's 'organic fertiliser marketing' activity in a few figures:

- ✓ 800 000 tonnes of organic fertilisers per year;
- ✓ 100 supply sites;
- ✓ 3 000 farmers using SEDE's organic fertilisers

The Challenge

HOW TO MEET FARMERS' INCREASING DEMAND FOR FERTILISERS RICH IN POTASSIUM?

The Pas-de-Calais region of France is a cereal, beet and potato producing area. The soils are mainly silty, poor in organic matter (OM) with low structural stability. Local farmers usually supply compost such as "TradiSol" to balance the humic rate of their crop rotation and provide nutrients. It is made by recycling the surrounding sewage sludge and green wastes. It complies with the French standard NFU 44-095, but does not provide enough potassium (K) to the crop systems. The return of compost to the soil contributes to the development of the Circular Economy and reduces the decline in the OM content of agricultural soils, while at the same time combating climate change. The challenge for SEDE was therefore to provide farmers with an "all-in-one" solution: a joint contribution of OM and K while retaining a local origin and being made of recycled co-products.

SEDE VEOLIA

Interreg North-West Europe ReNu2Farm
European Regional Development Fund

Success story of **SEDE Environnement**

"Our goal: to enhance organic matter, to fertilise soils"

Jacques Le Stum,
SEDE Environnement

The Solution

EXTRACT AND PROCESS MORE POTASSIUM

In order to find a source of K from their own recycling process, the SEDE's subsidiary Sani developed an extraction technique (*Figure 2*): in confined environment and without the addition of water, by pumping the bottoms of liquid and pasty vinasses, then mixing them with a drying agent to give them a satisfactory physical appearance.

TRADISOL K

SEDE now offers farmers Tradisol K (*Figure 3*), compost NFU 44-095 with a K content increased from 0.6 to 0.9% in the basic compost, and to 2.9% in the compost supplemented with potash. When applied in quantities of 6 to 8 tonnes/ha, it meets the OM needs of soils and potash requirements of demanding crops.

Figure 2: Sani's extraction technique

TradiSol K
NFU 44-095

Figure 3: Logo of TradiSol K compost

The Implementation

MAKING TRADISOL K COMPOST

The mixture of sewage sludge with shredded green waste and the vinasses is laid out in swaths. After first fermentation phase with forced aeration and turning (which lasts three weeks), the mixture is placed under the building for second fermentation phase of three weeks. The compost is then screened and the maturation phase begins, which lasts six weeks.

Control analyses are carried out at all stages of compost production by independent laboratories.

After the implementation step, SEDE invested in a specific mixing unit capable of guaranteeing a good homogeneity to the mixture (*Figure 4*).

Figure 4: Compost with vinasses mixing unit

The Advice

The production of compost, as well as of any recycling-derived fertiliser, needs to consider precisely the needs of farmers for nutrients as well as the environmental and agronomic benefits the final product can provide.

Since 1997, SEDE has been participating in the QUALIAGRO research program conducted as part of a collaboration between INRAE and Veolia Research and Innovation. The objective is to characterise the agronomic value of composts of urban origin and their environmental impact compared to manure, based on a long-term field trial and laboratory work. After 20 years, the main results are: i) organic fertilisation allows yields equivalent to mineral fertilisation ii) OM inputs improve the soil physical properties iii) organic fertilisation induce low levels of metallic trace elements in soils and plants and iv) a low risk of trace organic compounds.

SEDE VEOLIA

Interreg
North-West Europe
ReNu2Farm
European Regional Development Fund

Germiflor (France)

Success story of **Germiflor**

"We are convinced that well-composted plant bases are the true dynamics of soils"

Jacques Barthès,
Chairman

The Company

HISTORY

Founded in 1885, Germiflor is one of France's oldest family-owned companies in the field of organic fertilisers. It is located in the South West region of France: in Mazamet (Tarn department).

Jacques Barthès and his wife Dominique (*Figure 1*) took over the company in 1979 and gradually developed 100% plant-based fertilisers, adapted "à la carte" according to the problems of each soil and/or crop type.

They modernised and expanded the infrastructure, increasing the production from 8 000 tonnes/y in the 1980s to four times more today.

In 1999, Germiflor invested in a pellet manufacturing unit to meet the demand of their customers for an alternative to traditional powders.

To date, the company no longer produces manure compost and has specialised in 100% plant-based compost.

CURRENT BUSINESS

Every year, the company produces over 30 000 tonnes of fertilisers, in compliance with sustainable development principles, out of which 80% is approved for use in organic farming. Germiflor covers all types of plant productions: viticulture, vegetables, arboriculture, horticulture as well as arable crops. It is the first manufacturer in the world to hold the VEGAN Label with its 100% Vegetal UAB range in compliance with the European regulation on Organic Agriculture n°834/2007.

The company has a 6-hectare manufacturing site and a modern production unit that enables it to control all the operations involved in the collection of materials from recycling, the manufacture of tailor-made organic fertilisers, their packaging and their delivery to client cooperatives and agricultural trading companies. Germiflor is currently preparing an important investment project (new production unit on the same site) in order to further improve the quality of their products as well as the volume to meet tomorrow's needs.

Figure 1: Germiflor's Team

The Challenge

CONTROLLING THE HEALTH STATUS OF ORGANIC FERTILISERS

In recent years, agriculture has experienced very intense climatic and economic vagaries. Regulation has become increasingly draconian following the mad cow crisis in the 1990s. The following four general ideas guide the legislation on fertilisers and growing media:

1. products placed on the market must be effective for their intended use,
2. products must be harmless to humans, animals and the environment,
3. products must be stable, and
4. the products must refer to an official technical document.

As a result, the company was faced with the challenge of changing its corporate strategy in order to continue to offer its customers organic fertiliser products with proven effectiveness and guaranteeing an impeccable sanitary status.

Germiflor LAUTIER
Interreg North-West Europe ReNu2Farm
European Regional Development Fund

Success story of **Germiflor**

"We are convinced that well-composted plant bases are the true dynamics of soils"

Jacques Barthès,
Chairman

The Solution

The solution was to change the company's strategy and specialise only in the production of fertilisers made from the recycling of vegetal organic matter. This is due to the fact that the sanitary management of livestock effluents used historically (e.g. droppings, manure, etc.) was considered to be more risky, because livestock effluents can carry faecal enterococci or Escherichia Coli. The plant materials used are free of pathogenic germs and weed seeds. They also are rich in humic value, which ultimately helps to protect crops and consumer health.

The Implementation

MAZOR®

MAZOR® is a 100% plant-based product created by Germiflor (*Figure 3*), resulting from a synergy of 5 raw materials of plant origin and natural bacteria rigorously selected for their quality and safety from coffee grounds, olive pulp, vinca leaves, grape pulp and marc.

These materials are composted over a minimum period of 6 months, to which is added an additional month of

ENSURE THE TRACEABILITY AND TRANSPARENCY OF RAW MATERIALS AND FINISHED PRODUCTS

Germiflor has an INTERNAL HENRI laboratory which carries out, thanks to a spectrophotometric machine, analyses to confirm the entry of raw materials into the site and to validate the dispatch of goods (*Figure 2*). At the same time, the finished products are controlled by external COFRAC-accredited laboratories, and the MICROHUMUS® and RITTMO Agroenvironnement® laboratories supervise the company's internal laboratory and quality department teams. The overall cost of R&D and analyses is around 300 000 €/y.

Figure 2: Germiflor's raw materials and finished products in the laboratory.

SCIENTIFICALLY PROVE THE ACTIVITY OF MICROORGANISMS

The partnership with RITTMO Agroenvrionnement® and MICRO-HUMUS® has also made it possible to show by microscopic imaging that the microorganisms in MAZOR® are of natural origin and give the product hygienic and disinfectant properties for soils (*Figure 4*).

MAZOR® OR Vegan

NF U 44-051

Figure 3: Mazor®, a 100% vegetal fertilising product

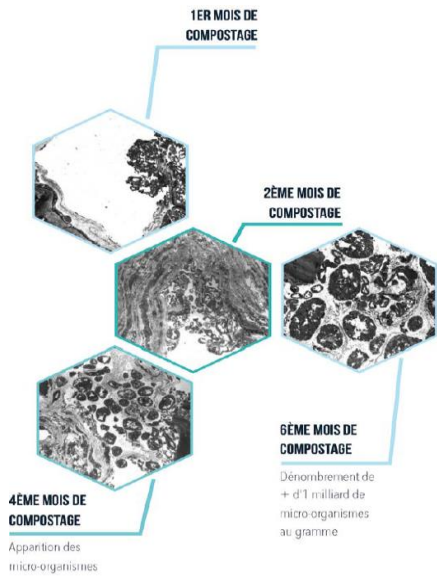

Figure 4: Use of microscopic imaging, to identify and characterise the beneficial contribution of microorganisms

The Advice

Organise your own sanitary pre-checks in the laboratory to increase your reactivity for dispatching orders in an increasingly tense market.

Germiflor LAUTIER

Interreg North-West Europe ReNu2Farm
European Regional Development Fund

Ökobit (Germany)

Success story of **Ökobit GmbH**

"This plant is a technical milestone for mobilisation of solid organic substrates - now and in future."

Christoph Spurk,
CEO of ÖKOBIT GmbH

The Company

HISTORY

ÖKOBIT GmbH, founded in 2000, is an owner-operated company with an exceptionally wide range of services and expertise in the field of anaerobic digestion (AD). The company's team comprises of business experts, and energy and environmental engineers working with full commitment on the implementation of environmentally compatible AD concepts worldwide.

In 2010, the company's 100th AD project was completed and continuing their success story with the foundation of a subsidiary in France "Agrogaz France" in 2014.

ÖKOBIT looks back on more than 250 realised AD projects in 2020 worldwide.

CURRENT BUSINESS

As a major manufacturer and planner of AD plants with over 250 national and international projects, the ÖKOBIT is one of the most sought-after full-service suppliers within the AD industry. The company develops and builds technically intelligent, substrate-flexible biogas and biomethane AD plants which perfectly correspond to the specific local conditions of their clients.

ÖKOBIT relies on established and exceptionally flexible technological concepts and ensures their effective and safe implementation. As a general contractor, in addition to expert advice and profitability calculations, ÖKOBIT takes on all tasks from planning and approval to turnkey plant construction.

PEOPLE AND LOCATIONS

Figure 1: CEOs of ÖKOBIT GmbH, Christoph Spurk and Sebastian Schmidt.

Figure 2: The team of experts at ÖKOBIT GmbH

The Challenge

Substrates for biogas production will be provided in the future mainly by solid residues. Without a complex and expensive pretreatment, solid residues with dry matter (DM) > 30%, e.g. horse manure, cannot be used in wet fermentation process (DM < 15%). Especially for small quantities of residues, mainly in rural areas, the application of small-scale biogas plants with maximum of 75 kWel is a technical smart solution. Such small-scale biogas plants are currently available for wet fermentation with slurry only.

The application of solid residues is possible in small portions. The technically more favorable dry fermentation process (typically working with DM > 20%) generates electricity generation costs of > 20 €-cents/kWhel.

The aim of the new plant is the development and implementation of a feasible dry fermentation small-scale biogas plant for solid and stackable residues. Investment costs of 4000 – 6000 €/kWel and electricity generation costs of < 15 €-cents/kWhel (25% below the German EEG feed in tariff) shall be reached for such plants.

These challenges shall be surpassed by significantly lower construction, transport and storage costs accompanied by a strong regional approach for input residues and output digestate.

Figure 3: Target substrates (upper left to lower center): horse manure, straw and grass

ÖKOBIT
20 Jahre erneuerbare Energie

Interreg North-West Europe
ReNu2Farm
European Regional Development Fund

Success story of **Ökobit GmbH**

"Farmers are being enabled to use their own organic residues to produce own energy – and it's economical and technical feasible."

Sebastian Schmidt,
CEO of ÖKOBIT GmbH

The Solution

The plant implementation is based on an innovative "Bauherrenmodel". During the construction and operation phases of a prototype (TRL 6) deep knowledge on project planning and operational experience can be generated under real operation conditions. Optimisation measures e.g. for utilisation of different substrates and different operating states (flexible and steady-state gas and energy production, full and part load, etc.) can be developed and implemented in the running system.

Needs for adaption of legal regulations will be determined along the planning, implementation and operation chain. Subject to economic and technical feasibility, a TRL 8 is expected at project end, giving the participating SME the opportunity to finalize the system to a ready-to-market product ex post.

The input materials are horse manure, straw and grass which comes from local sources mostly green cut and horse farms. The produced digestate is being applied on the farmers land for agricultural purposes.

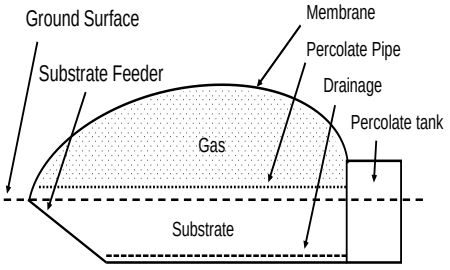

Figure 4: Sketch of plant design

The system itself, which is equipped with the 75 kWel CHP serves the farm regarding 100% GHG free supply with electrical and thermal energy needed for operation of the farm and private premises.

The Implementation

The plant is based on a farmer's site who initiated the first approach. This farmer entered into a collaboration with Ökobit GmbH in 2015 in order to further develop the system with regards to a corresponding reproducibility and marketability as described above in challenges. The self-built facility is located in the Herforst community at a height of 314 m and covers an area of around 5000 m², 1100 m² of which is sealed against spillage.

The system consists of three fermenters, each with a capacity of 360 m³ for substrates and 20 m³ for the percolate, with which the substrate inside the fermentation chamber is sprinkled from above. The solid area is sloped and can be driven on with a wheel loader. The width of the three fermenters is three meters each and the length approximately 20 m. A pipe system for percolation lies on the substrate. A weatherproof and gas-tight film is used as the gas storage membrane and outer skin.

Before opening the membrane, the substrates are degassed by sucking out the gas to prevent greenhouse gas (GHG) emissions while feeding with fresh substrate. Figure 5 shows the system in operation with inflated membrane.

Figure 5: The research plant in operation

The Advice

The utilisation of difficult substrates reduces wastes and saves resources. The local utilisation of biogas and substrates leads to high resource efficiency and the mitigation of fossil GHG emissions. The farm is getting sustainable and can compete on the agricultural market due to reduced waste disposal, energy supply and fertiliser purchase costs.

ÖKOBIT 20 Jahre erneuerbare Energie
Interreg North-West Europe ReNu2Farm
European Regional Development Fund

Berliner Wasserbetriebe & CNP CYCLES (Germany)

Success story of ***Berliner Wasserbetriebe & CNP CYCLES***

"AirPrex is a future-oriented and problem-preventing system with profitable results"

Andreas Lengemann, BWB

The Company

HISTORY

Berliner Wasserbetriebe (BWB) is a municipal company in Germany and takes care of water supply and wastewater in Berlin and Brandenburg. They operate six wastewater treatment plants in Münchehofe, Ruhleben, Schönerlinde, Waßmannsdorf (*Figure 1*), Stahnsdorf and Wansdorf.

The Berliner Process for phosphorus (P) recovery (*Figure 2*) was developed by BWB and the Technical University of Berlin, and implemented at the wastewater treatment plant in Berlin-Waßmannsdorf. The process is patented, but the license was granted to CNP CYCLES GmbH.

CNP CYCLES is a contractor and technology provider for municipal and industrial water infrastructure projects.

CURRENT BUSINESS

CNP supplies process technologies and plants for water and sludge treatment. CNP CYCLES offers technologies for the recovery of carbon (C), nitrogen (N) and P to close water and nutrient cycles, while generating energy for cost and resource efficiency. The goal is to create added value for people and the environment. CNP offers state-of-the-art technologies in integral concepts to create sustainable water infrastructures.

Figure 1: Waste water treatment plant in Berlin-Waßmansdorf

Figure 2: AirPrex® - plant in Berlin-Waßmansdorf

The Challenge

Biological phosphate elimination removes phosphates without the use of chemical precipitants. A negative side effect is the incrustation of pumps and other equipment due to the formation of magnesium-ammonium-phosphate (struvite) (*Figure 3*). This reduces the performance of the treatment plant and leads to high maintenance and operational costs.

Another disadvantage is the fact, that high phosphate concentrations in the sludge decrease its dewaterability, which leads to inefficient sludge dewatering.

Figure 3: Struvite incrustations in pipes

The implementation of biological P-recovery in addition to the digestion of concentrated sludge at the wastewater treatment plant in Berlin-Waßmansdorf led to major problems.

High P and ammonium content in the digested sludge plus spontaneous escape of CO_2 (increase of pH) led to uncontrolled struvite formation (*Figure 4*).

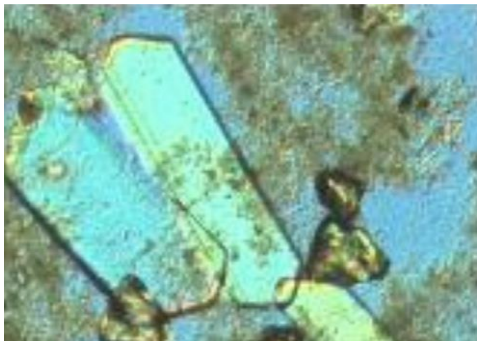

Figure 4: Formation of struvite in digested sludge

Berliner Wasserbetriebe
CNP CYCLES watering life
Interreg North-West Europe ReNu2Farm
European Regional Development Fund
EUROPEAN UNION

Success story of ***Berliner Wasserbetriebe & CNP CYCLES***

"AirPrex is a future-oriented and problem-preventing system with profitable results"

Andreas Lengemann, BWB

The Solution

BWB and Technical University of Berlin tested different approaches to avoid incrustations, e.g. dosing of anti-incrustation agents, use of magnets, CO_2 stripping. A negative side effect was the decreasing dewaterability of the digested sludge. Hence, tests for the precipitation of struvite were performed. The modified process included the use of $MgCl_2$ as precipitation agent and CO_2 stripping with air in the receiver tank before anaerobic digestion (*Figure 5*).

With pH elevation by stripping CO_2 and the addition of $MgCl_2$, a relevant share of the P content could be precipitated.

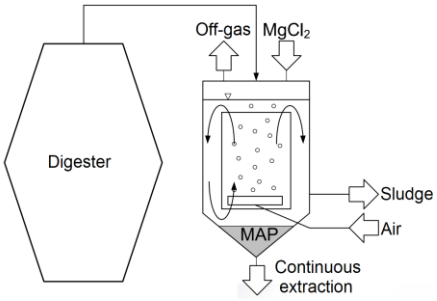

Figure 5: Struvite reactor in development stage

The modifications were successful with an intensified digestion, a major reduction of P, an improved dewaterability and the saving of flocculating agents.

These advantages led to cost savings of about 300 000 €/year. The optimisation of P recovery and the design of a new large-scale reactor for struvite precipitation were the objectives of further development projects.

The Implementation

CNP CYCLES has the license to distribute the Berliner Process and offers it under the name AirPrex®.

The AirPrex® process improves biological phosphate elimination. The digested sludge is fed into the AirPrex® reactor where it is subjected to CO_2 stripping through aeration. The CO_2 increases the pH of the sludge significantly. At the same time, the addition of magnesium salts leads to the formation and precipitation of struvite (magnesium-ammonium-phosphate - MAP) (Figure 6). The recovered MAP can be used as fertiliser.

Currently, there are 12 plants operating with the AirPrex® process in Germany, the Netherlands, and the United States.

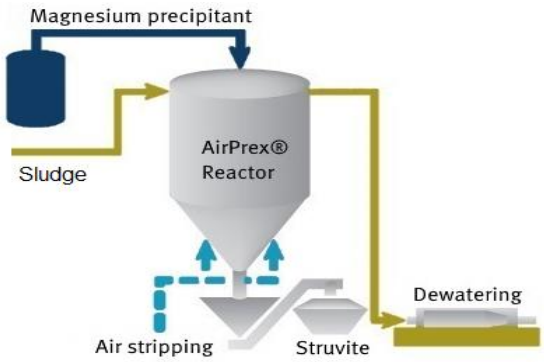

Figure 6: AirPrex® reactor for struvite precipitation

The Advice

The AirPrex®-Process is an excellent process to improve sludge handling on enhanced biological phosphorus removal (EBPR) plants, but EBPR is also a necessary pre-condition to recover struvite. Several modifications of the AirPrex®-process improve the recovery rates of struvite. To protect the line from the digester to the AirPrex®, a small quantity of crystallisation inhibitors can be added or a degassing system (e.g. DePrex) to control the formation of struvite, collect greenhouse gases and avoid scaling in the pipes.

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