

BIOGAS ADDITIVE

An **Evogen Microbial** product

Powder additive designed to stimulate, bolster and improve the efficiency of the anaerobic digestion process by using both chemistry and *Bacillus* bioaugmentation.



What is it?

A combination of a novel mineral based powder carrier and *Bacillus* microorganisms.



Uses

For AD systems operating up to 45°C. Suitable for most configurations and compatible with vast majority of organic feedstocks.



Eco credentials

Non pathogenic, non-hazardous, environmentally responsible and ready to use tool towards achieving improved bio-economy.



How it works

A combination of a novel mineral based carrier and *Bacillus* microorganisms that are designed to work with the AD process.

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PRODUCT AT A GLANCE

Evogen Biogas Additive is a powder product designed to stimulate, bolster and improve the efficiency of the anaerobic digestion process.

The mineral carrier provides a site for colonisation of methanogens and acts as an ion exchanger to boost the interspecies electron transfer.

The *Bacillus* strains have been selected for their ability to boost the hydrolysis and fermentation phases by the secretion of anaerobic active hydrolytic enzymes.

The synergy between the chemistry and biology act to boost biogas production and reduce final sludge volume.

The diverse metabolic capability of the *Bacillus* allow use in a wide range of reactor configurations and organic substrates.

Evogen Biogas Additive is manufactured in accordance with recognised international standard ISO 9001 to guarantee quality, integrity and reproducibility.

Stable spore formulations offer long term product stability.

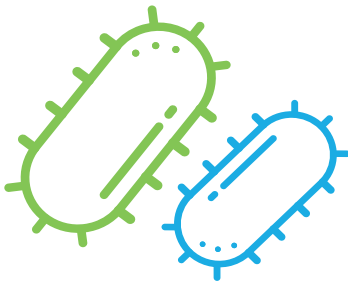
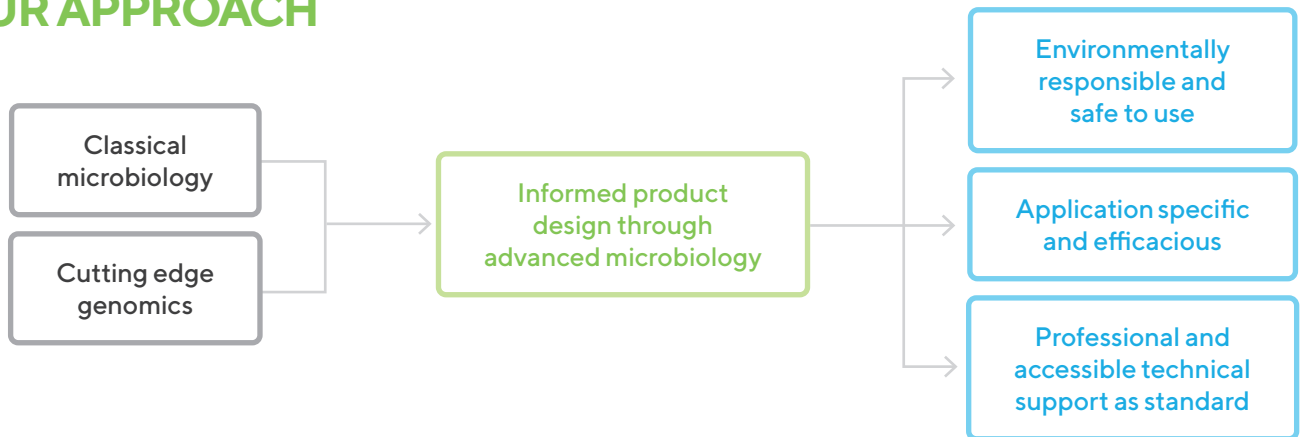
APPLICATIONS

- Sludge fed systems
- Agricultural waste fed systems
- Slurry fed systems
- Food and municipal fed systems
- Landfill leachate systems
- One phase configurations
- Two phase configurations
- Other complex configurations

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OUR APPROACH



What is *Bacillus*?

Bacillus are a genus of Gram-positive microorganisms found across the globe in a range of environments.

They are metabolically diverse and with a few notable exceptions are non-pathogenic and safe to use. They are able to survive when conditions move outside of those needed for survival through the production of spores.

Spore formation allows this type of bacteria to be grown in very high concentrations and blended into a stable product with a long shelf-life.

This makes it ideal for industrial applications where often a large amount of *Bacillus* cells are needed to amend a system.

Why is Genesis different?

At Genesis we ferment all our own bacteria to the highest standards (ISO 9001) so we can guarantee that the *Bacillus* we deliver are correct in both species and concentration and are free from contaminants. We have taken time to design our products to ensure they have minimal impact upon the environment and end user, whilst at the same time offering an efficacious and prolonged impact.

As *Bacillus* is our main technology, we ensure that we understand each of our isolates. We have invested in cutting edge genomic techniques to fully comprehend the potential of each of our *Bacillus* species, and in doing so we have created effective and truly application-specific technology. All of our products come with expert technical support as standard.



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THE TECHNOLOGY

Evogen Biogas Additive is a biotechnological solution towards improving the anaerobic digestion system. It is a granulated powder that is dosed directly into the system.

It combines a novel mineral carrier with *Bacillus* bioaugmentation to provide a physiochemical and biological response. This synergy between chemistry and biology delivers significant improvements above and beyond using these technologies in isolation.

The carrier acts to bolster the most sensitive microbial components of the anaerobic digestion process; the methanogens and acetogens. Whereas the *Bacillus* acts to provide a hydrolytic boost to assist in the greater degradation and turnover of polymeric compounds such as proteins, carbohydrates and fats.

Through this synergy, Evogen Biogas Additive can increase the amount of methane produced, decrease the final sludge volume and help to bolster the system it is dosed into enhancing stability and overall productivity. Providing both economic and environmental improvements that contribute towards the closing of the bio-economic loop.

The combination of different *Bacillus* species and strains gives Evogen Biogas Additive a diverse mix of microbes that can operate over a wide range of pH values and temperatures, providing the operator with a versatile tool for the diverse range of reactor configurations and feed types present across different industries.

The strains within Evogen Biogas Additive are also known for their plant growth promoting properties and have the potential to improve the value of digestate and sludges destined for agricultural uses.

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HOW IT WORKS

The biotechnology platform is a combination between a novel mineral carrier and selected *Bacillus* microorganisms.

The novel carrier acts in a multi faceted manner to bolster the most sensitive portion of the anaerobic digestion process, which is that mediated by acetogens and methanogens.

The pores within the mineral surface allow for deep structure biofilm colonisation which confers an extra layer of protection to these microbes. This makes them more tolerant to environmental conditions such as swings of pH and exposure to inhibitory compounds like ammonia.

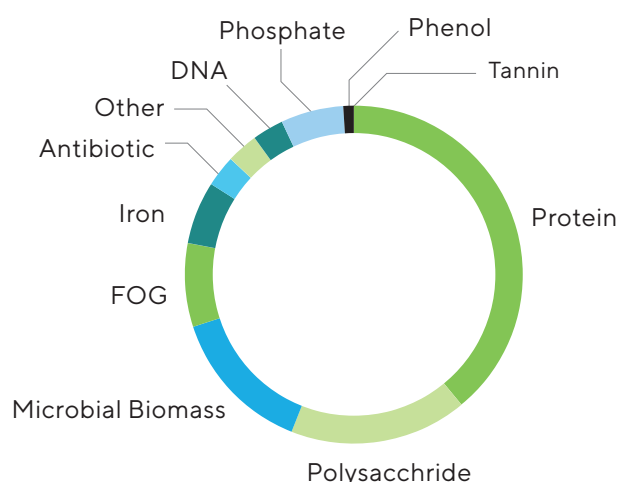
The surface of the mineral acts as an ion exchanger and facilitates the interspecies electron transfer, greatly facilitating anaerobic respiration.

The surface of the mineral is also able to absorb compounds such as ammonia and hydrogen sulphide, reducing their inhibitory impact upon the system as a whole.

The *Bacillus* consortia have been chosen due to their diverse metabolic capability and ability to operate across a range of pH and temperature values.

The capacity of the *Bacillus* to secrete hydrolytic enzymes under anaerobic conditions boost the degradation of a range of polymeric compounds found in sludge such as protein, polysaccharides and fats. This helps to liquefy sludge making substrates bioavailable for further degradation and subsequent methane generation.

The ability to form resistant spores ensures that they will only germinate when the right conditions allow them to, offering long term product stability and specificity.



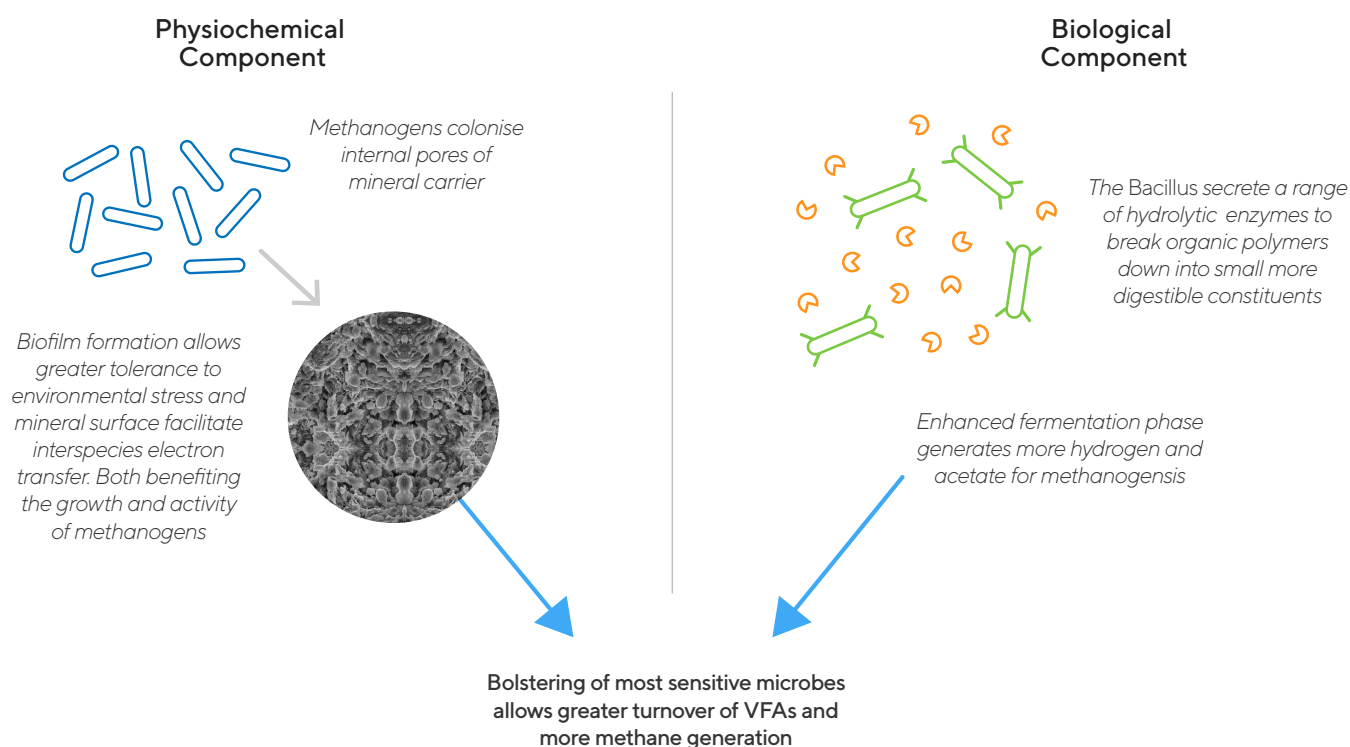
The pie chart shows the distribution of genes encoding extracellular hydrolytic enzymes of the *Bacillus* consortia. Testing under anaerobic conditions showed many of these enzymes to be active and effective, allowing the *Bacillus* in Evogen Biogas Additive to enhance the breakdown of common polymeric substances found in sludge and other organic substrates.

- ✓ Anaerobic protease activity
- ✓ Anaerobic cellulase activity
- ✓ Anaerobic lipase activity
- ✓ Anaerobic amylase activity

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HOW IT WORKS



The diagram shows the mechanisms of action of Evogen Biogas Additive and demonstrates how both the physiochemical and biological components work in synergy to deliver improvements to the anaerobic digestion process.

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CASE STUDY OVERVIEW

A single stage WWT sludge fed system was dosed with Evogen Biogas Additive over a 3 month period.

The plant receives 240m³ of WWT sludge per day with 10% of that volume coming from the chemical-physical of landfill leachate.

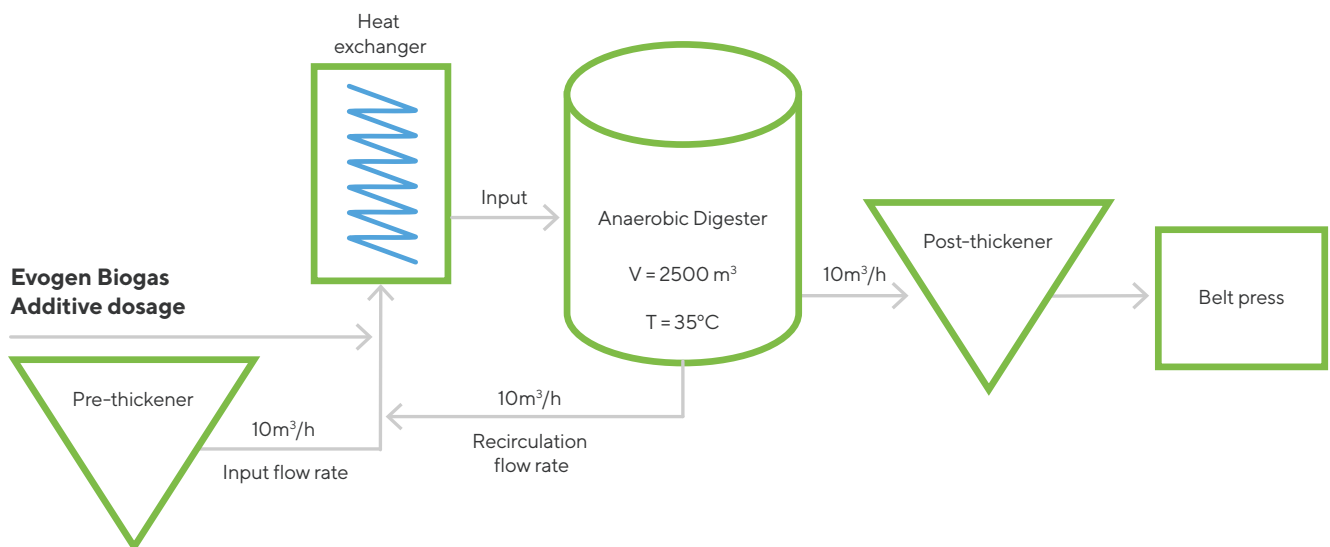
It operates at pH 7 and 35°C with a residence time of 10.4 days.

A boiler is used to heat the sludge which is powered by both diesel and biogas.

The sludge is disposed of via landfill after thickening using a flocculent and belt press.

Evogen Biogas Additive was dosed at 0.15% of the dry matter inlet concentration, with an initial slug dose of 50kg followed by a daily dosage of 10kg.

Dosing was performed on site using a modified tank to create a slurry with influent and pump it into the system before the heat exchanger.



The above diagram and pictures shows the layout of the single stage WWT sludge fed plant and the dosing tank set up to feed the system. A small footprint is required for the tank which mixed influent with product to create a slurry which was then dosed into the system.

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CASE STUDY RESULTS

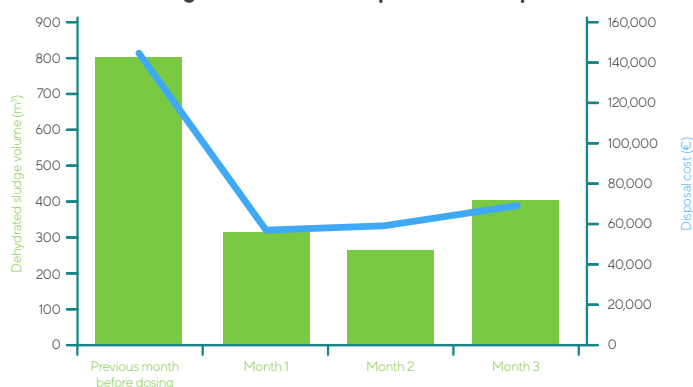
Dosing of Evogen Biogas Additive was able to significantly reduce sludge volume by half and double biogas production consistently during the trial period.

This resulted in significant cost savings from less boiler diesel usage, lower flocculant use and lower sludge disposal costs. The overall cost saving over the trial period totalled just over €215,000.

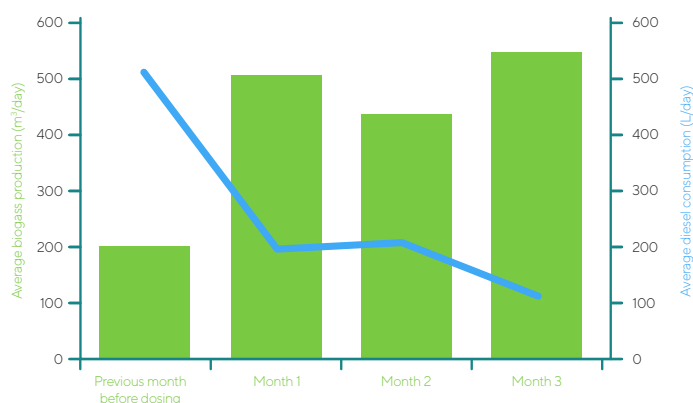
Overall, Evogen Biogas Additive was used as a cost effective tool to not only improve plant efficiency but positively impact the plants environmental parameters by reducing sludge production and diesel consumption.

The performance of Evogen Biogas Additive will vary from plant to plant due to configuration, operational and substrate differences and you should contact your local Genesis representative for advice before dosing to achieve best results.

Sludge volume and disposal cost impact



Biogas production and diesel consumption



The above graphs show the relationship between sludge reduction and disposal cost over the trial period and biogas production and diesel consumption. It should be noted seasonal effects did not impact the results according to historical data.

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DIRECTIONS FOR USE, CONSIDERATIONS AND LIMITATIONS

Evogen Biogas Additive is supplied in a 20kg pack size as standard.

The dosage point is flexible but must be as close to the start of the system as possible, such as with the feed substrate or injected into the line feeding the main digester. Success has been reported by forming a slurry with the influent in a separate tank and using this to dose the system.

We recommend at a minimum to dose at 0.1% the volume of dry weight entering the system. A loading dose of 0.1% of the estimate total dry weight present within the digester should be delivered initially before regular dosing proceeds.

For optimal results dose on a regular or continual basis at the recommended dosage of 0.1% dry matter.

Limitations

The carrier will provide performance across a range of reactor configurations and conditions from mesophilic to thermophilic conditions.

The *Bacillus* component will perform at a pH range of between pH 5 – 9 and will function optimally at mesophilic conditions up to temperatures of 45°C.

Performance has not been tested under thermophilic conditions and more testing is underway in this regard.

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PRODUCT SPECIFICATION

Count

1E+9 CFU/g

Fragrance

Neutral

Form

Free flowing
granular powder

Shelf life

24 months

Appearance

Grey/white

ENVIRONMENTAL CONDITIONS

Salinity

Freshwater to seawater
and above (no impact
upon performance
between 0 - 50 g/L)

pH

pH 5 - pH 9

Temperature

Mesophilic up to 45°C

Substrate type

WWT sludges, agricultural
wastes, animal slurries,
municipal waste and other
organic based wastes.

TALK TO OUR WASTEWATER SPECIALIST

At Genesis Biosciences, Dr. Chris Charles uses his experience in working with environmental samples alongside molecular and applied microbiology techniques to tackle some of the biggest bioremediation issues facing various industries.

By looking into the genomic blueprints of our *Bacillus* strains, he can determine the different genetic attributes and metabolic potentials of the bacteria within our library.

This type of cutting edge analysis helps to not only direct our research but also to ensure all the bacteria that goes into our products are truly application specific.

More information and how to order

Please visit website to see our FAQ.

t. +44 (0)29 2079 1185

e. wwt@genesisbiosciences.com

w. genesisbiosciences.co.uk



Dr. Chris Charles
Research Scientist
Genesis Biosciences