Schmack

VIESMANN Group

METHANOS® – high performance bacteria for increased biogas plant efficiency

Service

Micro-organisms – the way to significantly increase gas yield

Utilising the potential in the biological process

METHANOS® bacteria being produced on an industrial scale.

The biogas sector has witnessed rapid development over recent years and above all in the field of plant technology, which is undergoing continuous improvement. Thanks to many years of research and practical experience, our understanding of the biological processes has also increased. This experience is now being used to ensure that biogas plants are operated on an economically-viable and sustainable level, in accordance with renewable energy legislation.

The primary objective of the sector, however, must be to strive for ongoing increases in plant efficiency. This would make biogas so cheap to produce that it becomes competitive with fossil fuels – even in the absence of government funding. Within the sector, it is widely acknowledged that further work is needed to get the most out of the biological process. In this particular area, there is still a lot of untapped potential.

Over recent years, researchers at Schmack Biogas have been working intensively on these challenges.

Our microbiologists have succeeded in isolating high-performance bacteria, the introduction of which accelerates the production of biogas in the digester. Schmack Biogas is able to produce these bacteria in large quantities. The product – known as METHANOS® – has been patented and has already received numerous awards.

METHANOS® is a mixture of two different types of bacteria which occur naturally in biogas plants, though only in very small amounts. Through the addition of METHANOS® into the biogas process, the concentration of highly-efficient bacteria is increased. It is this which leads to the increase in efficiency of the biogas plant.

Comparison of METHANOS® with traditional biogas plant preparations
The main difference is that METHANOS® is based on living organisms. These organisms work in the “enzyme factory” of the digester and produce their own enzymes – a long-term, sustainable process. The enzyme preparations used up until now are, by comparison, rapidly degraded in the biogas plant by the microorganisms living within it.

METHANOS® – process-accelerating high-performance bacteria

100 % more output with no digester upgrade

Introducing METHANOS® can mean a 100 % performance increase with no major outlay
The addition of METHANOS® to biogas plants promotes focused control and optimisation of the biogas process. This results in a significant increase in plant efficiency without the need to make expensive changes to technical specifications.

Increase in degradation rate
Introducing METHANOS® has been shown to increase specific feed material gas yields by as much as 10 – 20 %.

Improved pump and agitator capacity
The homogeneity of the digester content and the ease with which it can be pumped and agitated are markedly improved. This makes the entire digestion process more stable.

Increase in volume load
Volume load in the plant digester can be increased by up to 100 % (up to a maximum of 7.0 kg organic dry matter/m^3*d). This means that biogas plants can be operated at more than twice the installed output without any alteration to the digester. In other words, twice as much heat and electrical power can be produced with no plant modification.

Feed material substitution
The addition of METHANOS® permits traditional feed materials (such as maize and GPS) to be replaced by substrates that are more difficult to decompose – e.g. grass and solid manure. Consequently, expenditure on feed materials is reduced.

Efficiency
The addition of METHANOS® increases biogas plant profitability. Due to increased volume load, biogas plants can be designed smaller, so plant operators benefit from reduced investment costs. Due to higher degradation rates, the introduction of METHANOS® results in 20 % more energy being produced from the same amount of biomass. This means increased plant output for the same amount of substrate feed, or the same plant output using less feed, i.e. reducing substrate feed costs. The improved pumping and agitating capacity of the substrate reduces both energy consumption and component wear and therefore brings down operating costs.

Compatibility
METHANOS® can be successfully deployed in round digesters (wet fermentation), plug flow digesters and garage-type digesters (dry fermentation). This means a variety of substrate variations can be used – from renewable raw materials and agricultural fertilisers to organic residues, such as bio-waste. The product can be used trouble-free in a wide range of biogas plants, irrespective of plant size or substrate mix.

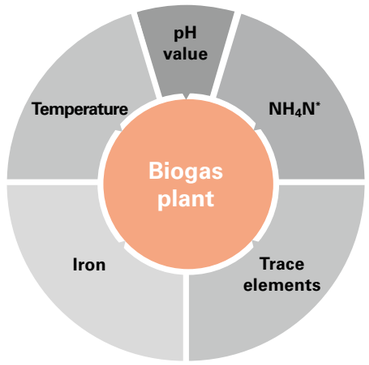
METHANOS® are living organisms, which in the “enzyme factory” of the biogas plant are capable of producing their own enzymes.

Improved efficiency due to:

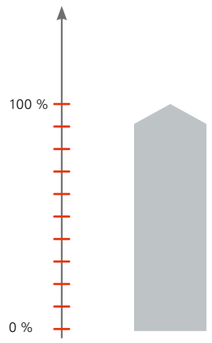
- Increased specific gas yields of up to 20 %
- Optimisation of substrate usage due to higher degradation rates
- Doubling of volume load with no accompanying increase in digester size
- Lowering of operating costs whilst at the same time increasing yield
- Freedom to alter substrate mix (substitution)
- Capacity to optimise biogas plant operation
- Lowering of energy consumption due to reductions in viscosity
- No additional costs incurred by the introduction of METHANOS®

Biogas plant process parameters

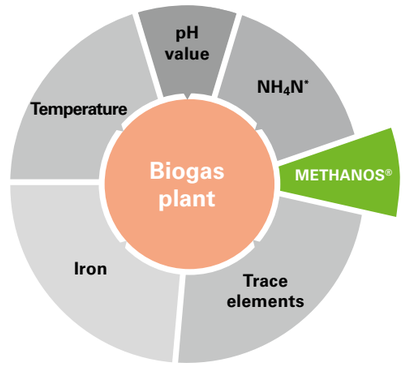
The key factors for optimal plant operation



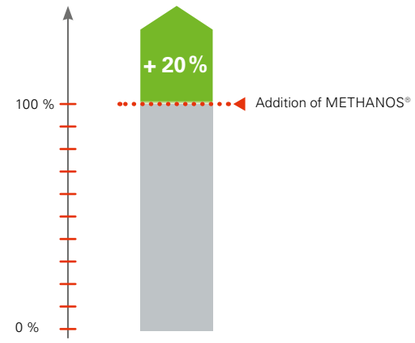
100 % biogas plant performance is achieved when all controlling parameters have been fully satisfied.



Biogas plant performance in kW_{el}



Under these conditions, the addition of METHANOS® increases output by up to 20 %.



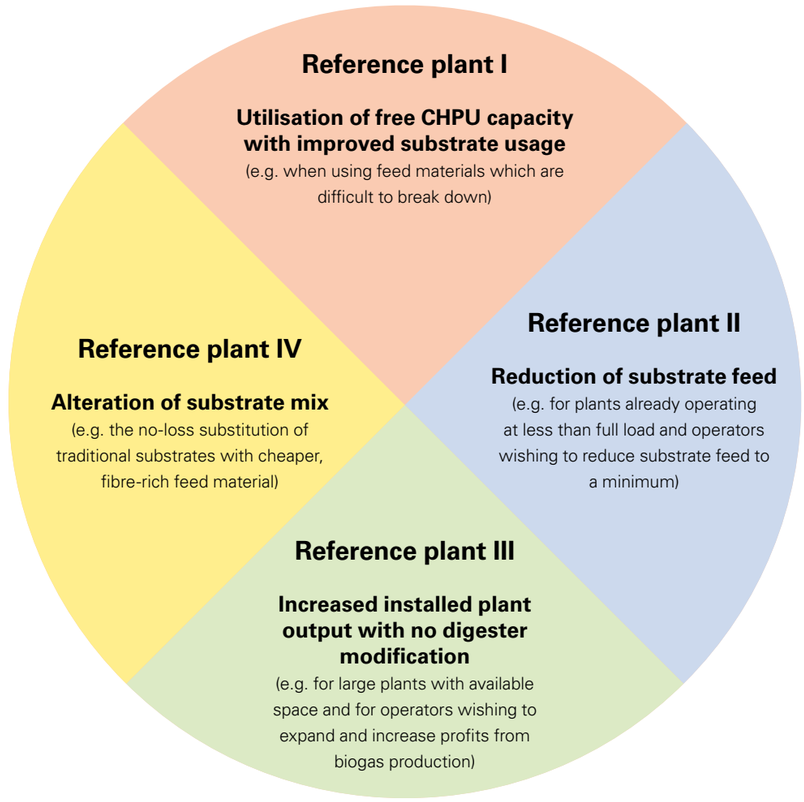
Biogas plant performance in kW_{el}

*Ammoniacal nitrogen

Introducing METHANOS® means every plant operator can achieve more

The effective solution for a wide range of scenarios

METHANOS® is suitable for use by all biogas operators interested in increasing plant efficiency. The following very different objectives can be pursued:



Basic requirements:

- The biological maintenance and provision of the contents of the digester must be established
- Guaranteed supply of good quality substrate
- A high level of technical availability

References

METHANOS® – Examples of practical application

Four reference plants and their performance data

■ **Reference plant for Scenario I:**
In operation since June 2011

1 x PASCO charging unit with 40 m³ capacity

2 x COCCUS round digester with 800 m³ capacity

1 x CHPU performance rated at 300 kW

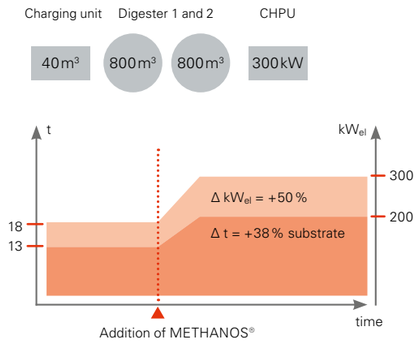
Feed:
Prior to the addition of METHANOS®: 13.2 t/d (rounded to 13 t/d)

Following the addition of METHANOS®: 17.9 t/d (rounded to 18 t/d)

Increased substrate use: 5 t/d or 38 %

Power output prior to the addition of METHANOS®: 200 kW
Power output following the addition of METHANOS®: 300 kW

Increase in power output: 100 kW or 50 %



The addition of METHANOS® improves degradation capacity and increases output by 50 %.

50 % increase in output, optimised plant utilisation

■ **Reference plant for Scenario II:**
In operation since December 2010

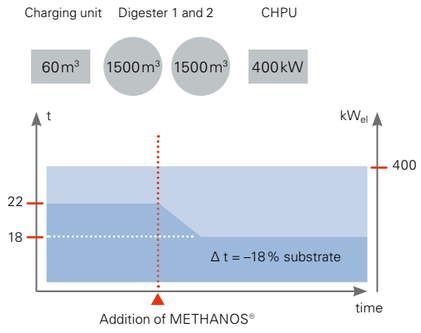
1 x PASCO charging unit with 60 m³ capacity

2 x COCCUS round digester each with 1500 m³ capacity

1 x CHPU performance rated at 400 kW

Feed:
Prior to the addition of METHANOS®: 22 t/d
Following the addition of METHANOS®: 18 t/d

Savings: 4 t/d or 18 %



METHANOS® means getting more gas from the same quantity of biomass, i.e. getting the same plant output from a reduced amount of substrate.

18 % less substrate usage for the same plant output

■ **Reference plant for Scenario III:**
In operation since December 2011

1 x PASCO with 30 m³ capacity

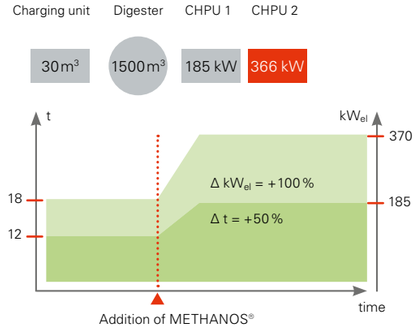
1 x COCCUS with 1500 m³ capacity

1 x CHPU (existing) power rated at 185 kW

1 x CHPU (upgrade) power rated at 366 kW

Feed:
Prior to the addition of METHANOS®: 12 t/d
Following the addition of METHANOS®: 18 t/d
Increased substrate use: 6 t/d or 50 %
Power output prior to the addition of METHANOS®: 185 kW
Power output following the addition of METHANOS®: 370 kW

Increase in power output: 185 kW or 100 %
(with no upgrading of the digester)



When upgrading biogas plants, the addition of METHANOS® brings about a simple increase in installed plant output, with no accompanying increase in digester size.

100 % increase in plant output with only 50 % more substrate

■ **Reference plant for Scenario IV:**
In operation since November 2011

2 x PASCO with 80 m³ capacity

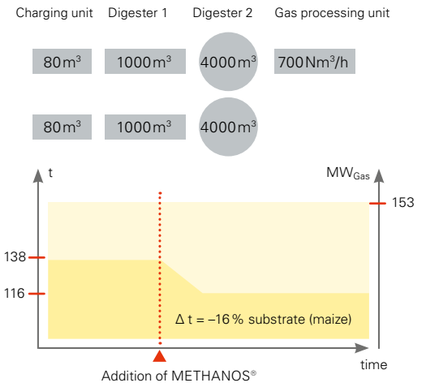
2 x EUCO with 1000 m³ capacity

2 x COCCUS with 4000 m³ capacity

1 x PSA (gas processing plant) performance rated at 700 Nm³ bio-natural gas/h

Feed:
Prior to the addition of METHANOS®: 138 t/d (maize)
Following the addition of METHANOS®: 116 t/d (maize)
Substrate saving: 22 t/d or 16 %
Output prior to addition: 153 MW gas/d
Output following addition: 153 MW gas/d
A saving of approximately 8000 t substrate/year

Increase in grass/WPS ratio of up to 60 %



METHANOS® allows traditional feed materials such as maize to be replaced by substrates that are more difficult to break down – with no reduction in performance.

Substitution of feed materials with no loss of plant output

Best Practice

Output doubled by re-powering and introducing METHANOS®

The Popps get more out of their biogas plant

Franz Popp from
Wattenberg near Bamberg, Germany

How it began
Franz and Andreas Popp from Wattendorf near Bamberg, Germany, installed a 185 kW Schmack biogas plant on their farm in 2005. In order to receive the slurry bonus, the plant was fed with 30 % cattle slurry. In order to continue running the farm economically in the future, the two men were faced with the decision of either increasing their milking stock or improving the performance of their biogas plant. With the ongoing threat of an end to the milk quota, investment in new milking facilities seemed too risky, so the two men opted for a re-powering of their biogas plant in 2011.

The solution
When re-powering at the end of 2011, a second CHPU was installed by ESS (Viessmann Group), so that the plant was able to operate at installed outputs of 366 kW_{el} and 430 kW_{th}. The plant was also converted to dry fermentation with a higher proportion of energy crops (maize and grass). Instead of the slurry bonus, the Popps now receive the EEG dry fermentation bonus of 2 cents per kilowatt hour. In order to further increase plant output, METHANOS® high-performance bacteria were introduced at the same time as the new CHPU was brought on-line.

The conversion
Following the initial injection of METHANOS® high-performance bacteria, plant feed requirements immediately jumped from 10 to 20 tonnes. Two days later, the new combined heat & power unit was brought into operation and after four days, the plant was already running at full load capacity. Under normal operating conditions, METHANOS® only needs to be added once per week to ensure the plant operating status is maintained.

The result
Thanks to re-powering and the addition of METHANOS®, Franz and Andreas Popp have been able to almost double the output of their biogas plant without having to upgrade their digester. The plant is now processing a much greater amount of feed: the volume load has increased from 2.9 to 4.9 kg of organic dry matter per m^3/day. Since METHANOS® high-performance bacteria support hydrolysis in the digester, pumping and agitating capacity has been improved – even at higher grass ratios. The result: the entire digestion process runs on a more sustainable basis.

Performance indicators

- **Plant output:** 366 kW_{el} and 430 kW_{th}
- **Volume load:** 4.9 kg oTS per m^3/day
- **Substrate mix:** up to 71 % grass and GPS

A few more things you should know about METHANOS®

Important information on use and handling

In order to preserve viability, METHANOS® bacteria are added while deep frozen.

Handling
Start by setting the digester to the optimal concentration of METHANOS® high-performance bacteria. A larger amount of METHANOS® (a one-off "kick-start" dosage) is initially used. The optimal dosage of METHANOS® is given by the digester volume and cell density parameters (0.5 – 1 % bacteria concentration in the digester). Once normal operation has been established, METHANOS® dosing is carried out on a regular basis – normally once per week. The normal dosage for a medium-sized biogas plant is approximately 1 kg, but "overdosing" with METHANOS® does not result in any negative effects.

Delivery and storage
METHANOS® is delivered to the plant regularly (every three months) in a ready-portioned, deep-frozen condition. It should be stored in a normal (proprietary) freezer at –20°C (freezer not included in the delivery). METHANOS® can be safely kept under these conditions for at least 12 months.

Adding METHANOS®
METHANOS® is normally fed into the digester via a screw-feed unit or dosing station. The feed unit should be completely empty prior to beginning the feed process. It must be ensured that the bacteria are not allowed to thaw out and re-freeze, since this can result in their viability being reduced. Where adequate feed arrangements are not available on existing plants, the digester can be fitted with a special METHANOS® feed port.

When will you be stepping on the gas with METHANOS®?

Our specialists will be happy to advise you

How to get started with METHANOS®
We offer you a METHANOS® package to suit your needs. Our customer care specialists are on hand to check the dosage needed for your plant and advise you on the necessary biological support. The conditions of sale are clearly set out in a supply contract.

Stopping the supply of METHANOS®
The supply of METHANOS® can be stopped at any time and the plant returned to the mode of operation used prior to METHANOS® deployment. The natural conditions and microorganism composition that existed before the introduction of METHANOS® are re-established within a few weeks.

METHANOS® is an award-winner
METHANOS® is acknowledged as an outstanding innovation within the biogas sector. The product received an Award of Recognition at the Bayern Energy Awards in 2010 and received the Innovation Award of the German Agricultural Society in 2011.

Note:
Prior to introducing METHANOS®, it must be ensured that the existing agitating mechanism and feed technology arrangements are compatible with the planned increases in volume load and substrate throughput.

METHANOS® is easily fed into the digester by means of a screw feed mechanism.

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