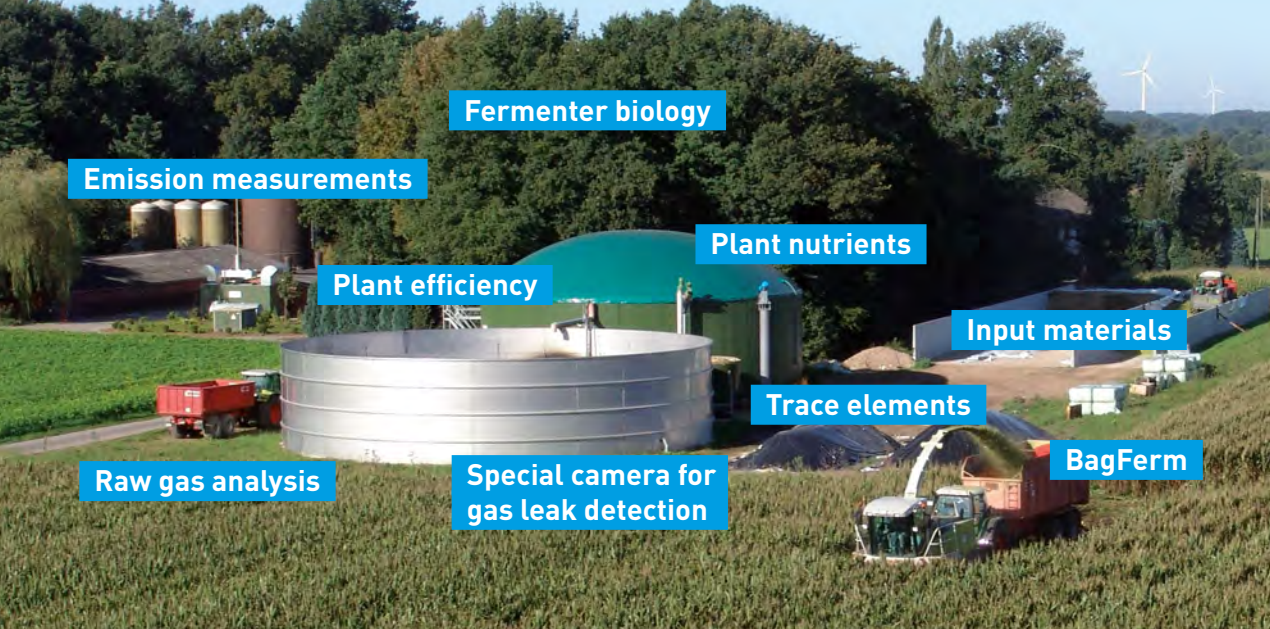


Biogas – Solutions from a single source

Consulting, analysis, planning

Safe, economical, neutral and independent





Biogas – Solutions from a single source

With competent, individual consultancy, punctual and high-quality analytical services at our accredited laboratories, the WESSLING biogas experts are your reliable partner in all questions regarding biogas solutions from a single source.

WESSLING provides a unique range of services and is regarded throughout Germany and internationally as an exceptionally competent service provider in the field of biogas. The WESSLING experts continuously work to improve the yield of biogas plants in an environmentally friendly manner. Time and again they themselves contribute significantly to progress in this field. **BagFerm** is the latest example of this active commitment to innovation. The WESSLING biogas experts use their newly developed method to determine the efficiency of any given substrate and ultimately the energy yield with greatest precision.

Our services for the biogas industry range from input, fermenter and digestate analysis to fermentation tests. Operational safety is ensured through gas leak detection, emission measurements and raw gas analysis. The assessment of biogas yield and ascertainment of key figures and mass balance complete the range of services.



Our services at a glance

- Analysis and assessment of input materials
- Fermenter substrate analysis
- Assessment of fermenter biology
- Digestate analysis
- Investigation of trace elements
- Gas leak detection with special camera
- Raw gas analysis
- Emission and formaldehyde measurements
- BagFerm – fermentation tests
- Consulting and planning

Trace elements

We analyse the fermentation substrate with highly sensitive measurement devices. In doing so, we determine the trace element content with precision and under consideration of the required detection limits. Since 2007, we have analysed thousands of samples and have carried out numerous fermentation tests regarding the provision of biogas plants with trace elements. Our consulting services aim at steadily increasing yield with optimal concentration levels while at the same time protecting the environment. This service for providing biogas plants with trace elements has been awarded the Innovation Award Münsterland in the category 'Energie innovativ'.



Plant nutrients

The analysis of plant nutrients should always take place before application of the digestate to ensure adequate use of the valuable fertiliser. In the event of the digestate being passed on, an analysis as per German Fertiliser Ordinance (DüMV - Düngemittelverordnung) should likewise be carried out in order to be on the safe side in any questions of liability. We will be happy to advise you regarding the necessary tests.

Fermenter biology

In the fermenter, the organic matter ferments to produce biogas. Our analysis of organic acids, buffer capacity, ammonium, dry mass, organic dry matter and pH-value ensures an optimal biology assessment and helps to identify disturbances in time. We place special attention on assessing the complete acid spectrum. This is the only way to obtain evidence of potential causes of process disturbances. In combination with organic dry matter, one can draw conclusions about potential volumes of residual gas. Fermentation tests provide precise assays in the event of evidence of residual gas potential.

Sampling

We will send you suitable sample bottles for sampling. We are the only laboratory to provide you with a special preservative for the acid assay. This preservative prevents decomposition of acids, eliminating the need for refrigerated despatch of your samples. We can precisely assess the sample values even after longer periods of unrefrigerated storage of samples.

Input materials

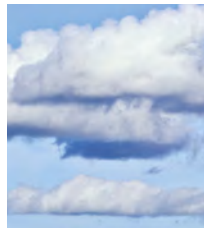
The input materials constitute the largest cost factor in the operation of a biogas plant. Only targeted analysis enables you to assess the value of your additionally purchased materials and to arrive at a fair price for both parties. We advise you regarding the optimal scope of analysis for your input materials. Potential analysis ranges from simple DM assessment to theoretical gas yield calculations and practical fermentation tests. We advise you which substances you should have analysed in the event of critical input materials to ensure maximum operational safety for your biogas plant.

Air pollution control bonus

The award of the EEC air pollution control bonus, also called formaldehyde bonus, requires the annual metrological proof of compliance with the limit values as per EEC. We provide these measurements, too. We support a large number of plants, enabling us to incorporate also individual plants in our measurement campaigns, thereby reducing the cost. We are happy to help should you be unsure whether you would benefit from such a measurement, whether it would make sense from a technical point of view and what framework conditions you are actually subject to in your region.

Emission measurements

The construction and operation of biogas plants is subject to approval. Depending on the installed furnace thermal capacity, a planning permission may be sufficient; however, larger plants require approval as per the German Federal Emission Control Act (Bundesimmissionschutzgesetz, BImSchG). The act, as well as also increasingly planning permissions, stipulates the emission limit values for various components that must be complied with in lawful operation. Compliance must be regularly verified through measurement by an institution named as per Articles 26, 28 BImSchG. This verification is one of the requirements for the lawful operation of your biogas plant.



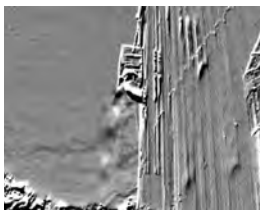


Biogas leak detection with special camera

Eight of ten biogas plants suffer from invisible loss of considerable amounts of gas. This is a huge economic loss for any operator of biogas plants. Studies have revealed that a loss rate of 2% in a 500 kW plant results in annual extra costs of EUR 7,000 for additional substrate use.

Our special camera detects gas leaks by way of schlieren photography almost independent of weather conditions. We will show you the leaks on site on the camera monitor. The documented data is an important requirement for sealing work. Even new plants within the warranty period may display leaks that can be claimed.

The WESSLING Group supports you in exploiting the potential of your biogas plant and remedying plant-specific faults.





Our services

- Camera scan of the entire biogas plant with a special camera to ascertain the actual state (biogas camera)
- State-of-the-art methane leak visualisation technology
- On-site analysis and documentation
- Video clips and photographs
- Consulting, including individual recommendations for the sealing of leaks under consideration of cost, time and quality

Your advantages

- Comprehensive support in increasing your biogas plant's yield
- Immediate and ongoing performance improvement
- Real-time investigation during operation as well as documentation
- Handover of new plants with the best possible capacities
- Short-term reamortisation through rectification of underperformance
- Independent consulting regarding the entire mode of operation
- Cost optimisation regarding substrate use, plant maintenance and oncost
- Additional explosion protection
- Identification of residual gas in the final repository

BagFerm: Determining the biogas yield



How high is the quality of the maize variety used as substrate in the biogas plant? Which new substrates can substitute maize in the biogas plant? **BagFerm** provides answers to these questions: The innovation by WESSLING for the biogas industry.

A newly developed method determines the efficiency of any given substrate and ultimately the energy yield with greatest precision. **BagFerm** models the real fermentation process in a biogas plant. The method's key element is a fermenter on a scale of 1:1000 for the decomposition of organic matter.

In it, hundreds of different substrate samples ferment at the same time under the same conditions. This ensures accuracy of fermentation conditions and comparable results that allow for precise assertions regarding substrate efficiency in the subsequent laboratory analysis. For plant operators this means: exact recommendations for using the best possible substrate.

The substrate needs not always derive from maize. **BagFerm** is also used to test the efficiency of alternative raw materials such as straw, liquid manure, dung, intermediate crops and new varieties such as silphium perfoliatum and tall wheatgrass.

Our services

- Analysis of different raw materials intended for use as substrates in biogas plants
- Assessment of substrate efficiency and quality on the basis of a real fermentation process
- Analysis of hundreds of samples at the same time under the same conditions
- Determination of residual gas potential
- Individual consulting

Your advantages

- Precise recommendations for action
- Economic and ecological optimisation potential for your plant
- Comparability of different substrate types
- Personal contact partner





1 Sampling and sample preparation for BagFerm measurement



2 This is what it looks like: the maize silage under investigation

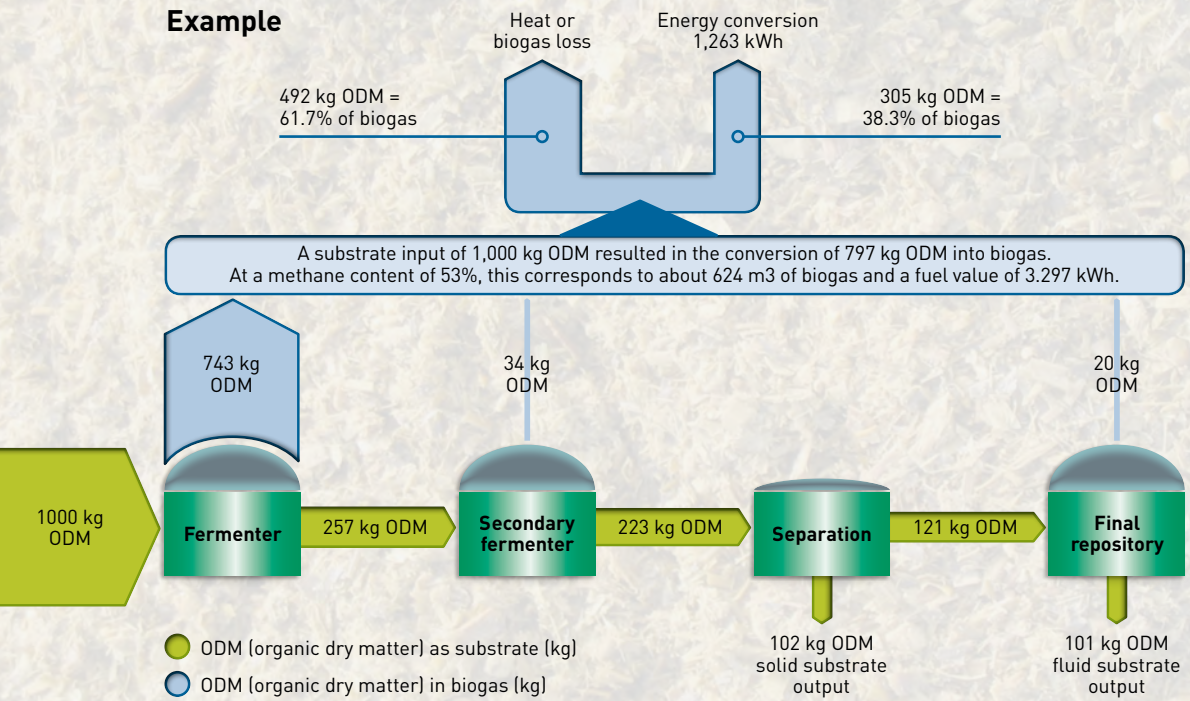


3 Back at the laboratory after measurement with BagFerm – Evaluation of digestate



4 Precise statements of yield: maize silage after 3, 20 and 30 days of fermentation in BagFerm

Example



Plant efficiency assessment

How efficient is your biogas plant? Numerous biological processes take place in biogas plants. However, if operators only keep an eye on methane yield, many processes remain hidden and deviations often get corrected too late. Regular surveys and assessments regarding plant efficiency offer more opportunities for reacting to changes and therefore for optimal economic management.

Our ascertainment of mass balance provides you with information about the entire output of your plant. To this end, we investigate all process stages in the biogas plant. You receive a comprehensive profile at a glance and find out how efficient your plant is, how much organic dry matter is converted into biogas. This comprehensive analysis moreover reveals how much biogas is generated in the individual process stages and even takes into account the feeding into the grid of the produced electricity.



Example in table format

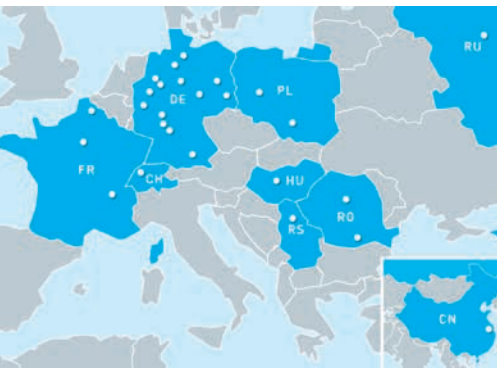
Key performance indicator	BGA XY	WESSLING references
Produced amount of electricity	378.057 kWh	
Produced amount of biogas (at 53% methane)	203.304 Nm ³	
Conversion ODM to biogas	79,7%	46,3 – 79,8%
Conversion biogas to electricity (at 53% methane)	38,3%	31,2 – 39,3%
Conversion organic dry matter to electricity	1.263 kWhel/t oTS	819 – 1.264 kWhel/t oTS

Our services

- Ascertainment of mass balance
- Ongoing evaluation over several months
- Analysis of organic dry matter
- Individual consulting

Your advantages

- Independent assessment of biology and energy generation
- Assessment of efficiency compared to other plants
- Regular evaluations for optimal plant performance
- Immediate visibility of weaknesses



WESSLING is an international and independent analytical, testing and consulting company represented at 26 locations in Europe and China. More than 1,600 employees work on the continuous improvement of quality and safety of products and processes of environmental and health protection. We examine, analyse, assess, survey, plan and implement projects – for the sustainable improvement of the quality of life.

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