

E.S.C.H.

Biogas

Range of Services

the Company

E.S.C.H. GmbH

department

Technology Development - Biogas-Production

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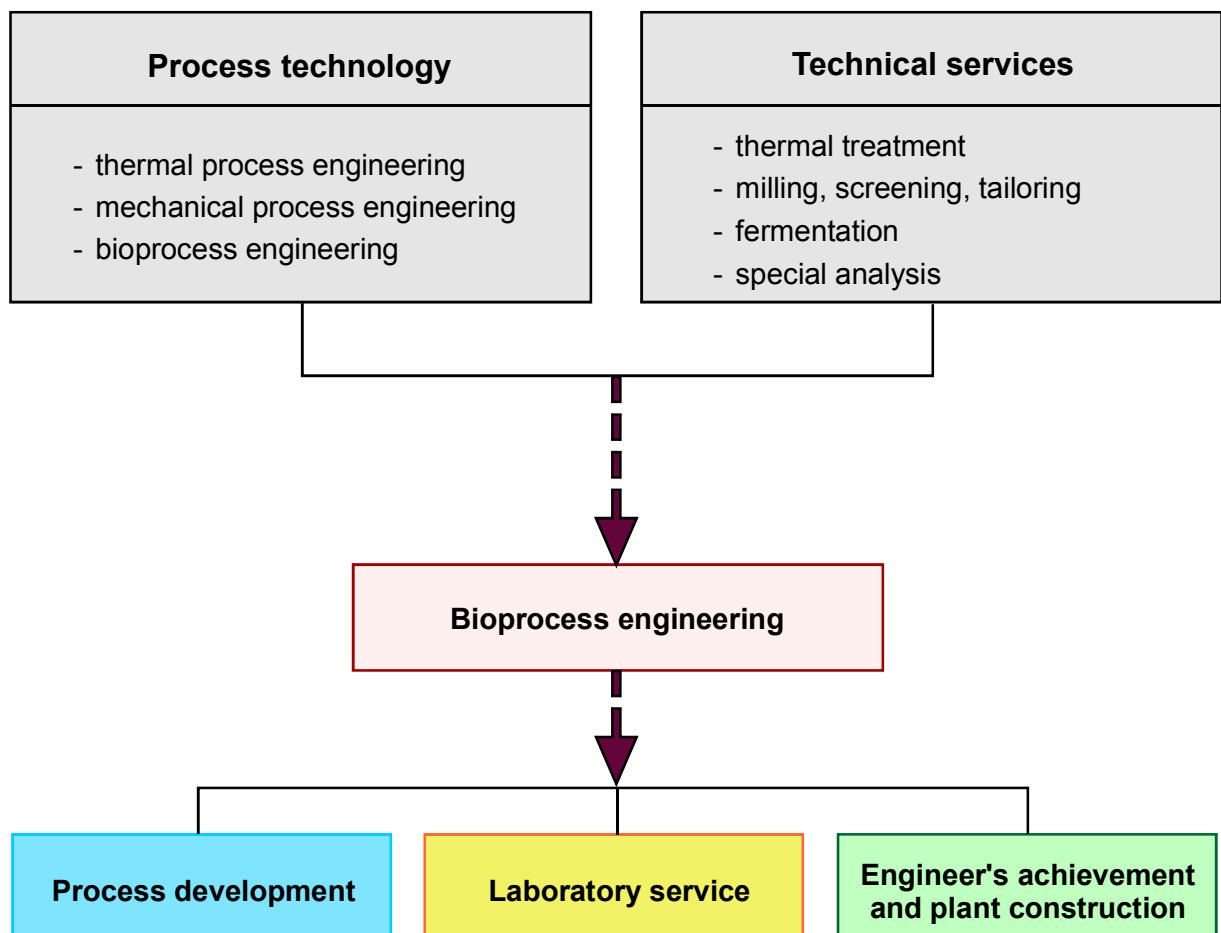
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Representation of the branch

Head office in Unterwellenborn



Branch office in Saalfeld



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Bioprocess engineering

Process development

- basic research
- fermentation in discontinuous and continuous digesters
- realisation of Gas analyses
- investigation of digestate
- processing and conditioning of mineral and native-organic substances
- recycling technologies
- automation systems
- optimisation possibilities

Range of services for customers

Laboratory services

- fermentation tests at laboratory
- substrate processing (mechanical, thermal, enzymatic)
- substrate characterisation (measurement of substrate-specific parameters)
- digestate utilisation (dewatering, granulation, thermal utilisation)
- Optimization of process conditions

Engineer's achievement and plant construction

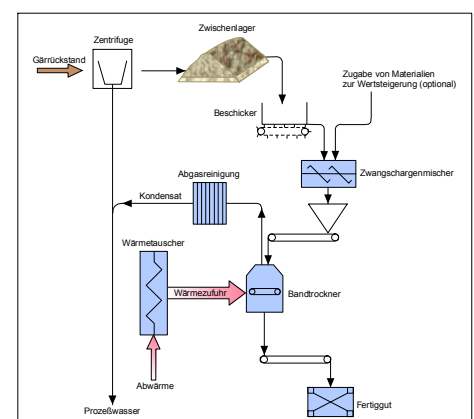
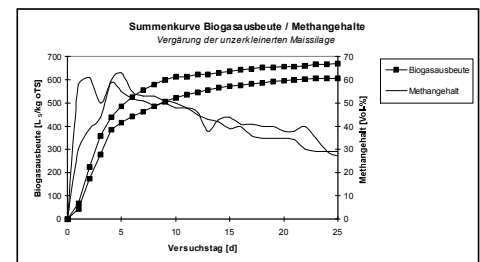
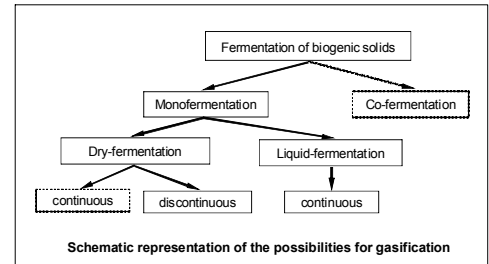
- energy consulting / assessment of potentials
- feasibility studies
- economical calculation for investment decisions
- plant construction
- weak point analyses, process optimization

Process development:

Research

Verfahrensentwicklung:

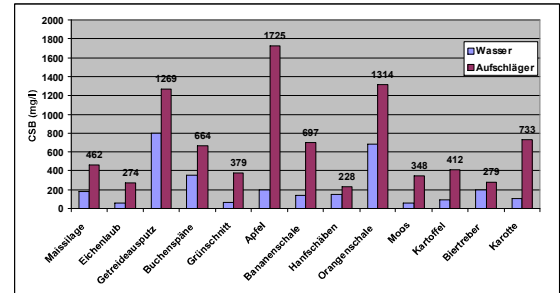
- **Scientific basis for production of biogas with solid technologies**
- **Basic investigations for substrate processing for fermentation tests and biogas production**
- **Experimental basics of anaerob technology as a part of waste water cleaning**
- **Utilisation of digestate from biogas production considering input of biogenic waste**



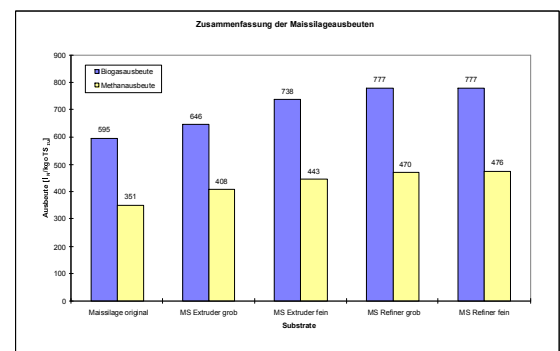
Process development:

Research

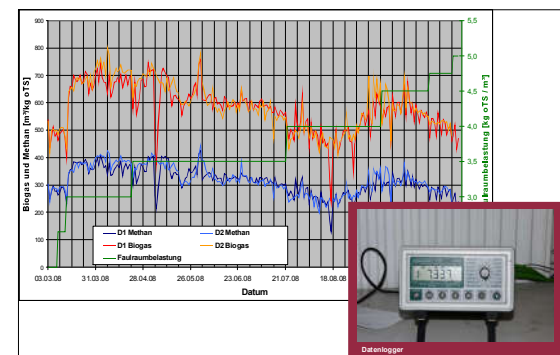
- Basic investigations concerning usage of anaerob fermentation depending on the waste composition



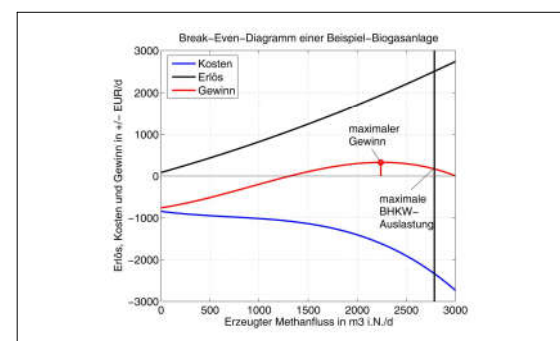
- Increase of efficiency of biogas plants by processing of co-substrates by means of thermic pressure pulse treatment



- Development of methods for characterisation of risk scenarios in case of anaerob decomposition of biomass and measures for risk minimisation



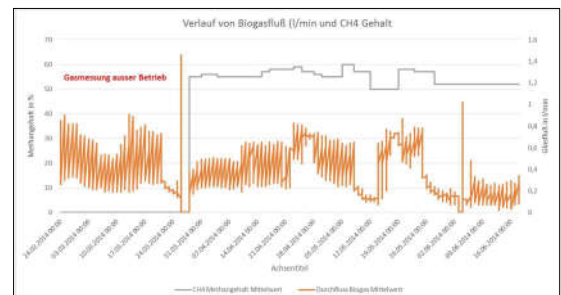
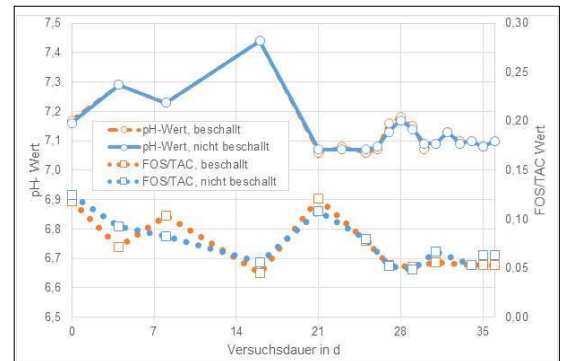
- Development of a flexible automation system for economic and demand-oriented power generation in biogas plants



Process development:

Research

- Increasing the biogas yield by introducing low intensity sound waves into the fermentation process
- Process and automation-technical adaptation of biogas plants to the requirements of a demand-oriented power generation; New plant concepts for an effective and flexible energy production from biogas



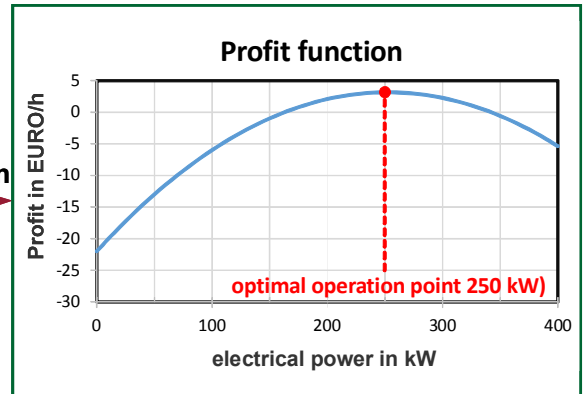
Process development:

Research

Process stability by automatic FOS/TAC measurement

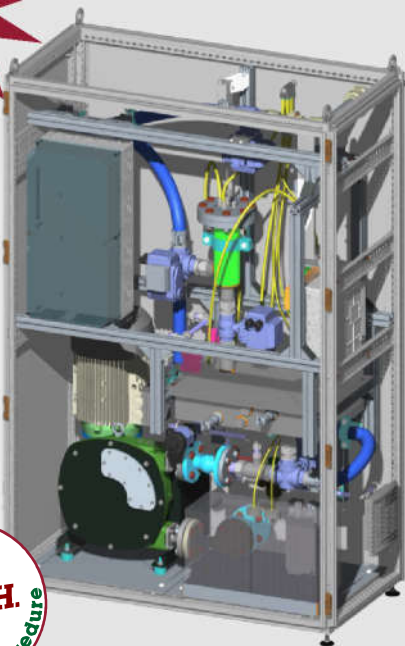


Improved flexibility and optimization

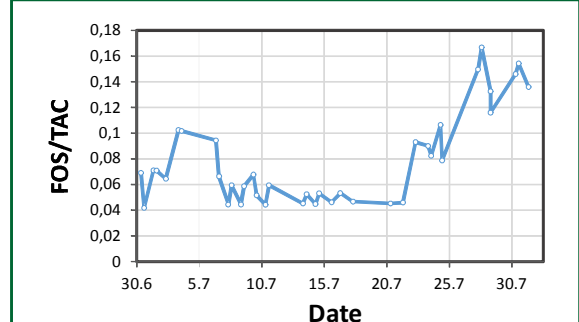
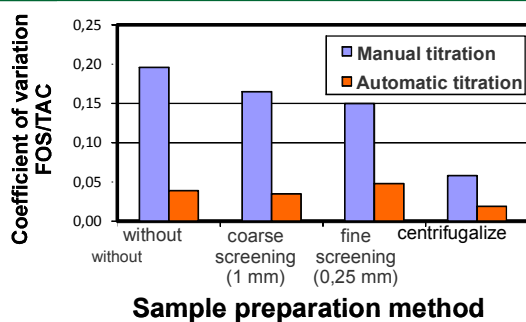


NEW-
development

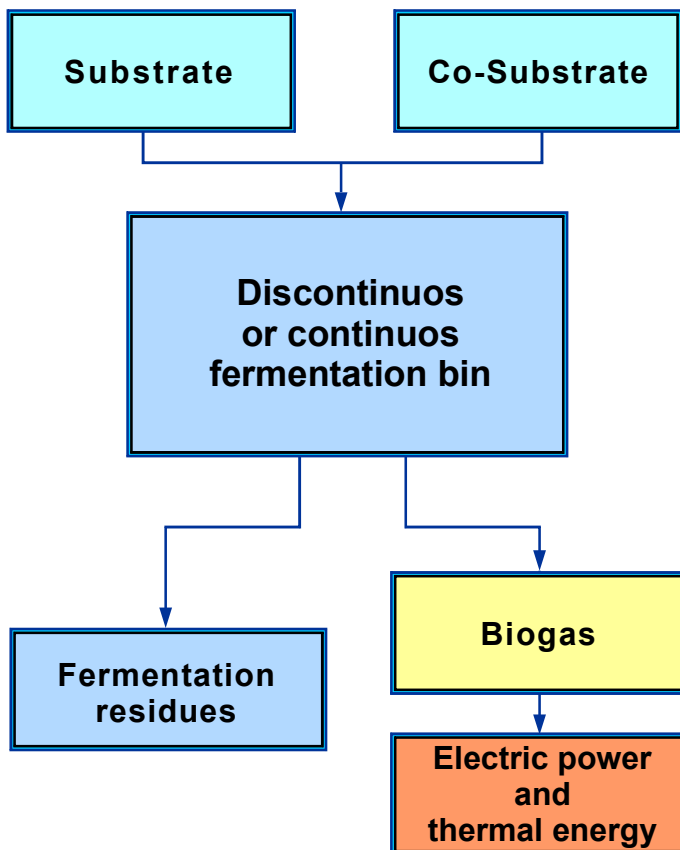
Patented
E.S.C.H.
measuring procedure



- ▶ maximum safety
- ▶ fully automated online measurement
- ▶ integrated sampling and sample preparation
- ▶ short measuring intervals
- ▶ high reproducibility
- ▶ applicable to all liquid digestion plants



Laboratory services



- **substrate preprocessing**
- **substrate characteristic**
- **fermentation testing**
 - measuring of biogas output and gas composition
 - optimisation of process conditions
- **efficiency observation**
 - characteristic of fermentation residues
 - concept of waste disposal
 - energy concept



30 l-digester for batch-tests



Continuous digester in the biogas laboratory

Technical backgrounds of our biogas laboratory:

- ▶ cracking, mixing, conditioning
- ▶ 1 l-, 2 l-, 20 l and 30 l digester for batch-testing
- ▶ 150 l and 500 l - digester for continuos fermentation
- ▶ Substrat and fermenter analytic: TS, oTS, pH-value, FOS/TAC, CSB, NH_4^+
- ▶ gas analytik: gas flow, CH_4 , CO_2 , O_2 , H_2S

Analytics accompanying the process - Offer for determination the data of biogas plant relevant to the process

- pH-value
- FOS/TAC-value
- Ammonium- and Phosphate-Concentration
- Decrease of TS/oTS
- Gas analytic
(gas flow, CH₄, CO₂, O₂, H₂S)
 - Weekly or monthly sampling and consulting
 - Mounting of process measuring technique
 - Process optimization and remote control for actual evaluation of critical process states.



Gas analyser

Fermentation testing as services

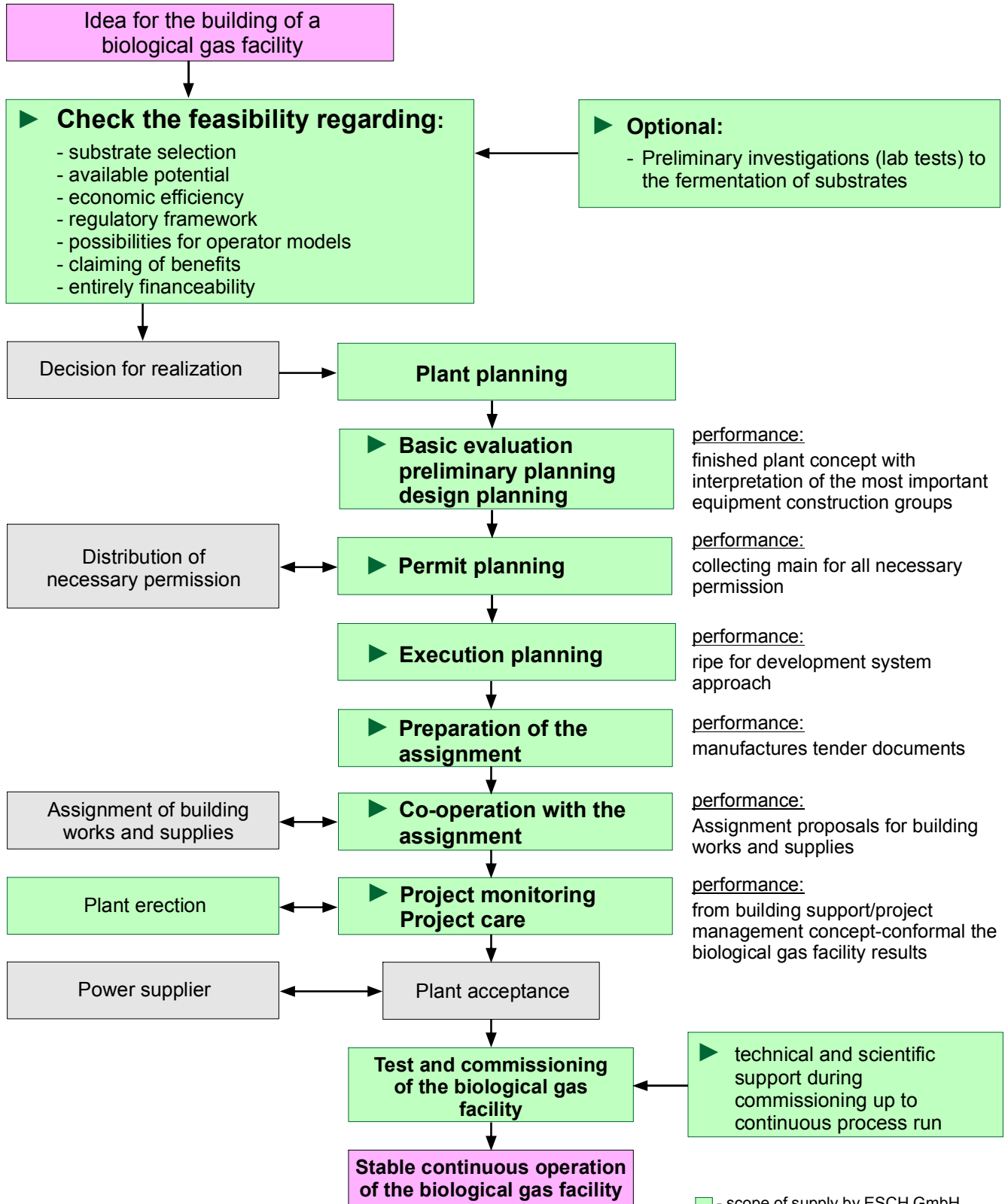
In different dimensions (batch testing in 1 l-, 2 l- 20 l and 30 l- Digester, continuous fermentation in 120 l- Digester and automatic 500 l- Digester) under variety of:



500 l Digester

- Preprocessing / preparation of samples
- Processing time
- Formation of liquid manure / cosubstrate
- Fermentation additive
- Organic loading rate
- Biogas cleaning and drying

Scope of supply plant design, construction and service



Glossary of parameters

► pH-value

To provide an optimal fermentation process, the negative decade logarithm of hydrogen ions concentration must be in neutral field between 6.8 - 7.4. Values under 6.8 indicate an acidification, i.e. level of carboxylic acids in fermentation substance is too high.

► OS/TAC-value

The value is the proportion of volatile organic acids (VOA) to carbonate (total unorganic carbonate) in fermentation process.

The value is determined through two-stages titration of centrifuged fermentation residues with 0.5 M of sulfuric acid in correspondence with working instructions of national department for agriculture in Braunschweig. Stable operation is usually guaranteed with the FOS/TAC proportion equal 0.3 by the Biogas plant. The value shows problematic operational states relatively early.

► Ammonium- and Phosphate-concentration

With too high concentration, Ammonium/Ammonia and Phosphate impede the fermentation process. The impeding concentration depends on fermentation substrate and concentration of carboxylic acids in the fermentation substrate. It is recommended to control the content to avoid concentration in particular with protein rich substrates.

► Decrease of TS / oTS

TS = dry substance in % of green weight

oTS = organic dry substance in % of TS (dry substance) value

The decrease of oTS correlates with generated biogas flow and allows to make conclusions about evolution of fermentation process.

► Gas analytik (Gas flow, CH₄, CO₂, O₂, H₂S)

Fermentation composition plays an important role for evaluation of fermentation process and energy output. Particularly with the usage of protein rich substrates, there can arise bigger flow of hydrogen sulfide, which must be significantly remote before biogas usage to avoid corrosion on block heat and power plant. Consequently, hydrogen sulfide impedes the decrease process already in little concentrations.

References

Selected References

Laboratory Services

Substrate preparation, digestion and analysis for:

- **Agricultural enterprise**
Norbert Wirsching, Rieth
 - Fermentation of liquid manure as co-substrate
- **AGD - Dorfilm Agrar-GmbH, Dorfilm**
 - Fermentation of liquid manure with co-substrate of food waste
- **Contrans GmbH, Markkleeberg**
 - Fermentation of wool slurry as co-substrate
- **Landesanstalt für Landwirtschaft und Gartenbau Sachsen-Anhalt, Bernburg**
 - Fermentation of liquid manure with Sudangrass as co-substrate
- **Suko Gesellschaft zur Herstellung von Substraten und Komposten mbH, Wolfmannshausen**
 - Fermentation of paper slurry as co-substrate
- **BioAktiv GmbH, Würchwitz**
 - Fermentation of pig slurry with additives
- **Hermann Walter GmbH, Inzingen**
 - Fermentation of food waste with pig slurry as mono- and co-fermentation
- **EIP GmbH, Rietz**
 - Mono-fermentation of pig slurry



Electric cabinet



Batch-digester (20 l)



Mini-batch-digester (1 l)

Substrate preparation, digestion and analysis for:

- **Taubergrund Biogas GbR, Insingen**
 - Continuous fermentation of food waste
- **Wiesneth Mühle GmbH, Pommersfelden**
 - Mono-fermentation of corn grinding waste
- **Zweckverband Wasserversorgung und Abwasserbeseitigung des Landkreises Saalfeld-Rudolstadt**
 - Fermentation of digested sludge from a municipal sewage plant with enzyme additive
- **Bäuerliche Produktion und Absatz AG, Hellingen**
 - Fermentation of liquid manure with whey
- **Agrarproduktion Reuth Sammer & Co. KG, Reuth**
 - Fermentation of liquid manure with chicken dung
- **Landesanstalt für Landwirtschaft und Gartenbau Sachsen-Anhalt, Bernburg**
 - Comparison of fermentation behavior of co-substrates sudan grass and maize
- **Thüringer Landesanstalt für Landwirtschaft, Jena**
 - Fermentation of power plants
- **EPC Anlagenbau GmbH, Rudisleben**
 - Fermentation of orange peel
- **VELARO GmbH, Wenigenauma**
 - Fermentation of rapeseed cake



Gas-Chromatograph



Gas-Flowmeter

Substrate preparation, digestion and analysis for:

- **Müller Speiseresteverwertung GmbH, Papenburg**
 - Continuous fermentation of food waste

- **Agrar- und Umweltanalytik GmbH, Jena**
 - Continuous fermentation of bio waste

- **Kuratorium für Technik und Bauwesen in der Landwirtschaft e.V. (KTBL)**
 - Round robin tests biogas output, system parameters

- **reg Energie GmbH, Plauen**
 - Investigation of fermentation behaviour of Jatropha-seed cake
 - Investigation of fermentation behaviour of ground rubber nut

- **Küttner GmbH & Co. KG, Essen**
 - Investigation of the fermentation behavior of sugar beet pulp
 - Investigation of the fermentation behavior of various paper sludges

- **IG Biogas GmbH & Co. KG, Neustadt/Fechheim**
 - Fermentation of rapeseed cake

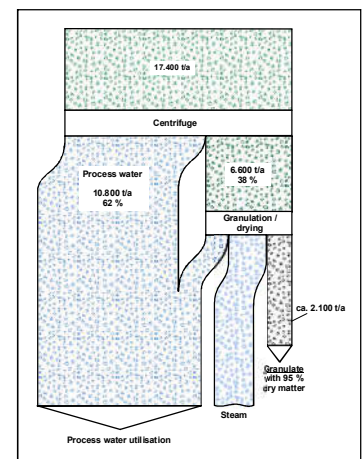
- **Biogasanlagen** Timmendorf, Kleingeschwenda, Wellmersdorf etc.
 - Detection of gas yield from digestate residue of biogas plants

System Support:

- Technological investigation for risk-minimization in care of co fermentation of paper fibres and paper slurry



- Consulting to thermal utilisation of digestate referring to process technology, efficiency and licensing law



- **Process analysis and Support of several biogas plants**
 - Sampling and analysis of liquid manure, slurry and digestate
 - Gas sampling and determination of gas composition
 - Determination of digestion load

Selected References

Engineering and Plant construction

▪ **Biogas plant Rieth**

with direct trigeneration

LWU Norbert Wirsching; 98663 Rieth

with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- construction Supervision / project management

Fermenter size: 800 m³ + 2 x 1.526 m³

Substrate input: liquid manure and pig slurry
maize and corn

Electric power: 275 kW_{el}



▪ **Extension building Rieth**

Trigeneration with a CHP for
climatisation of a piggery

LWU Norbert Wirsching; 98663 Rieth

with

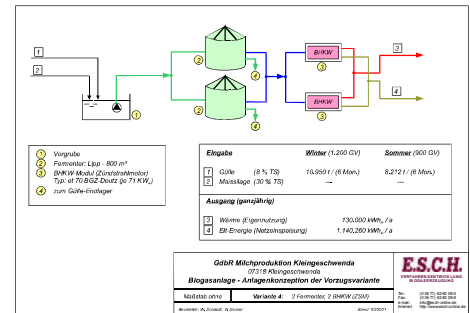
- design plant concept
- Project support



Selected References

Engineering and Plant construction

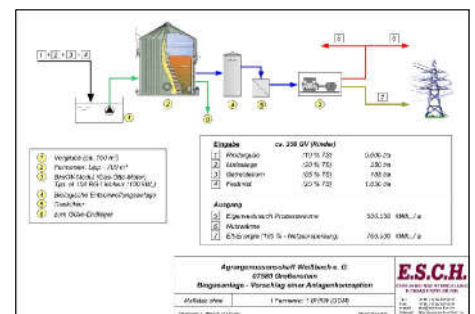
- **Plant concepts and cost efficiency analysis for about 40 biogas plants**



- **Biogas plant Großenstein**

Agrargenossenschaft e.G., 07580 Großenstein
with

- design plant concept
- efficiency considerations
- approval planning
- execution planning



Fermenter size:	1.300 m ³	
Substrate input:	liquid manure/	
	pig slurry:	22.000 t/a
	corn:	1.022 t/a
	feed waste:	1.500 t/a
Electric power:	372 kW _{el}	

- **Biogas plant Hellingen / Heldburg**

Bäuerliche Produktion & Absatz AG; 98663 Hellingen
with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- construction Supervision / project management



Fermenter size: 800 m³
Substrate input: liquid manure / maize silage
Electric power: 120 kW_{el}

Selected References

Engineering and Plant construction

▪ **Biogas plant Wellmersdorf**

IG Biogas GmbH und Co. KG,
96465 Neustadt / Fechheim
with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- construction Supervision / project management
- plant support



Fermenter size: 2 x 1.000 m³
Substrate input: liquid manure: 1.000 t/a
pig slurry: 5.000 t/a
maize and corn: 3.000 t/a
Electric power: 625 kW_{el}

▪ **Biogas plant Catharinau**

Agrargenossenschaft Catharinau e.G.
07407 Uhlstädt- Kirchhasel
with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- project management
- construction and commissioning
- plant support



Fermenter size: 1 x 1.000 m³
1 x 1.500 m³
Substrate input: liquid manure: 6.000 t/a
maize silage: 1.000 t/a
grass silage: 850 t/a
solid dung: 2.000 t/a
corn: 145 t/a
Electric power: 265 kW_{el}

Selected References

Engineering and Plant construction

- **Biogasanlage Untermaßfeld**

AGU-Agrargenossenschaft GmbH Untermaßfeld
98617 Untermaßfeld
with

- design plant concept with energy recovery and steam generation
- efficiency considerations

Fermenter size: 1 x 1.500 m³ digester capacity
1 x 1.500 m³ post digester

Substrat input: cattle manure: 7.000 t/a
maize silage: 3.350 t/a
cattle dung: 500 t/a
corn: 900 t/a
uneaten food: 260 t/a

Electric power: (electricity feed-in) 568 kW_{el}



- **Biogas plant Großenlütter**

36137 Großenlütter
with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- project management
- construction and commissioning

Fermenter size: 1 x 1.800 m³
1 x 2.600 m³

Substrate input: maize silage, grass, solid dung,
chicken dung 10.000 t/a

Electric power: 750 kW_{el}



Selected References

Engineering and Plant construction

▪ **Biogas plant Abtsbessigen**

Biogas-Abtsbessingen GmbH
99713 Abtsbessingen

with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- project management
- construction and commissioning



Fermenter size: 1 x 2.200 m³
1 x 3.600 m³
Substrate input: maize silage, corn: 6.570 t/a
liquid manure: 2.190 t/a
Electric power: 520 kW_{el}

▪ **Biogas plant Hammersfeld**

99326 Ilmtal Hammersfeld

with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- project management
- construction and commissioning



Fermenter size: 1 x 2.200 m³
1 x 1.800 m³
Substrate input: maize silage, grass silage,
solid dung: 45.625 t/a
liquid manure: 60.000 t/a
Electric power: 520 kW_{el}

Selected References

Engineering and Plant construction

▪ Biogas plant **Banya**

E. T. Trifonov, Cattle plant Banya
agricultural district Karlovo (Bulgaria)
with

- design plant concept
- efficiency considerations
- approval planning
- execution planning
- project management
- construction and commissioning

Fermenter size: 1 x 2.200 m³

Final repository size: 1 x 8.000 m³

Substrate input:	whole crop silage:	4 150 t/a
	peas / triticale silage:	1 700 t/a
	liquid manure:	12 050 m ³
	whey:	4 380 t/a

Electric power: 400 kW_{el}



