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3rd NATIONAL BIOGAS CONFERENCE

Midrand, South Africa, 03 Nov 2017

Biogas Monitoring – Technologies, Challenges, Solutions

Jan Talkenberger, Manager International Sales, Binder GmbH

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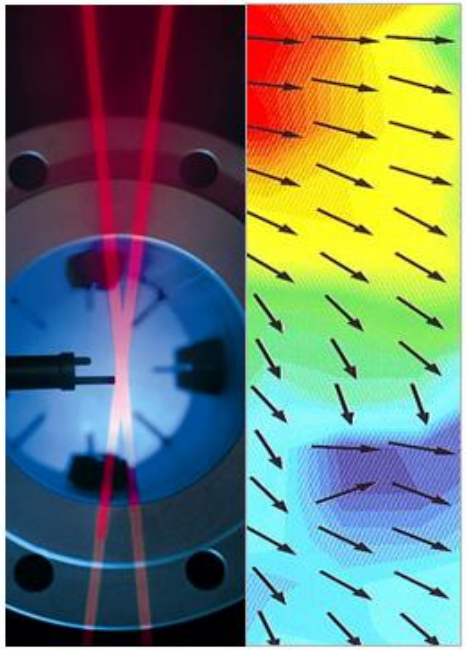
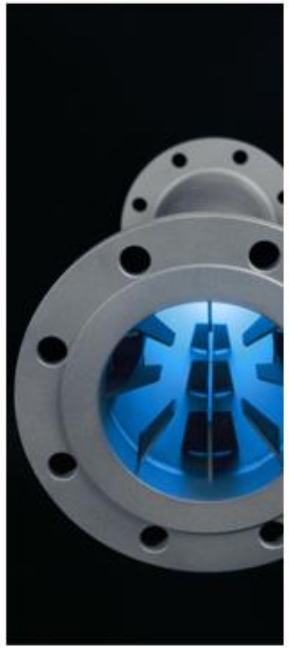
- Introduction
  - Binder‘s core business is Gas Flow Metering and Control.
  - Aeration Control System & Digester Gas Flow Metering & Gas Analysis

Real Gas Flow Calibration



Gas Flow Conditioning



Gas Flow Measurement

Gas Flow Control

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Binder Group AG **Finance Holding**

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MEASUREMENT & CONTROL

Binder Engineering GmbH **Sales & Service Companies in DE / F / CH / NL / B / China, Singapore, Malaysia**

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BINDER GmbH **Manufacturing Company for** Gas Flowmeter, Gas Analyzer and Control Systems with following products**: COMBIMASS® / VACOMASS® / CAMASS®**

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INSTRUM AG **Manufacturing Company for Stainless Steel Pressure Regulators and Valves**

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BETA B.V. **Manufacturing Company for Pressure and Temperature Switches**

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- Monitoring of gas quality and quantity
- Challenges and technologies
- Measurement of MJ
- Summary

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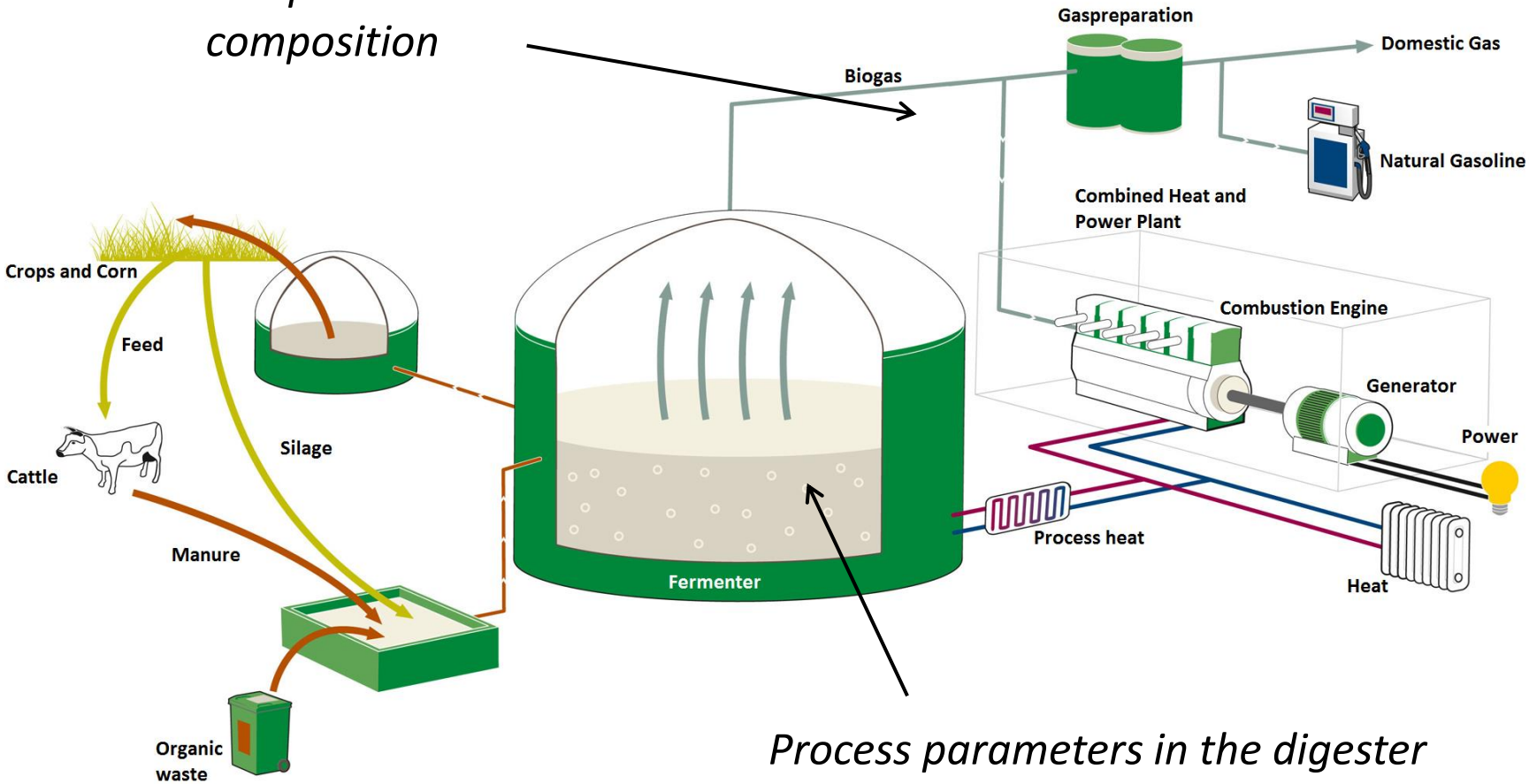
Why is it necessary to monitor Biogas Plants?

Parameters to be monitored in a biogas plant

Gas production and composition



Process parameters in the digester (pH, temperature, ..)

Equipment used for treatment and utilization of the biogas

- H_2S scrubber
- Blowers or compressors
- Biogas engine (CHP unit)
- Biogas upgrade technology (Membrane, …)

Typically this all are sophisticated and rather expensive devices.

How monitoring of biogas becomes essential

- Performance of H_2S scrubbers:
  - Control operation of H2S scrubber according to cleaning performance or oxygen values
- Control and adjusment of CHP units
  - Adjust engine parameters according to changing CH4 concentration
- Grid injection or other further use
  - Monitor gas quality (composition) and quantitiy

Example: Monitoring of H_2S concentration

- H2S filter shall clean the gas to a suitable concentraction for following equipment
- Performance of the H_2S filter depends on ist principle and handling
- H_2S concentraction at scrubber output must be monitored!
  - Scrubber performance check
  - **Protect the gas-using equipment, e.g. CHP engine**

Cost - CHP engine repair vs. Gas Analyzer

CHP breakdown	**Gas Analyzer**
CHP repair: 20.000 – 50.000 EUR	Purchase: 8.000 – 10.000 EUR
Loss of income: 1.000 – 10.000 EUR	Installation: 1.000 EUR
	Maintenance: 1.000 EUR / year
Total: 21.000 – 60.000 EUR	***Total: 10.000 – 12.000 EUR***
↓ Thread: bankruptcy of plant operator	<u>Additional benefit:</u> use measured parameter to operate the plant more efficient and economic
	

VEREIN DEUTSCHER INGENIEURE	Emissionsminderung Biologische Abfallbehandlungsanlagen – Kompostierung und Vergärung Anlagenkapazität mehr als ca. 6.000 Mg/a Emission control Biological waste treatment facilities Composting and anaerobic digestion Plant capacities more than approx. 6.000 Mg/a	VDI 3475 Blatt 1 / Part 1 Ausg. deutsch/englisch Issue German/English

„.. It is highly advisable to analyze the composition of the biogas in the raw state and before the CHP regarding CH_4, H_2S and O_2. Thus, changes in the biogas and the cleaning measures function can be monitored. The analysis must be made regularly at least daily. In case of unevenly distributed feeding and expected fluctuations in the biogas composition, the analysis frequency needs to be adapted.

It is advisable to use gas analyzer with set-limits and alarm and opportunity to integrate them into an existing plant control. Methane sensors must be pressure and temperature compensated; hydrogen sulphide sensors also need to be sufficiently resistant with peak concentrations. Regular calibration according to the manufacturer's instructions are generally to follow... "

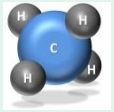
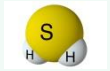
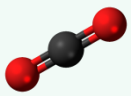
Why is process monitoring necessary?

- **Supervision** of individual components, e.g. H_2S scrubber
- **Protection** of sensitive equipment, e.g. CHP-engine
- **Preventive alarm** settings to react timely on process fluctuations
- **Improve** feeding cycles and reduce raw material usage
- **Comply** to legal requirements, e.g. evidence of biogas production and gas-quality

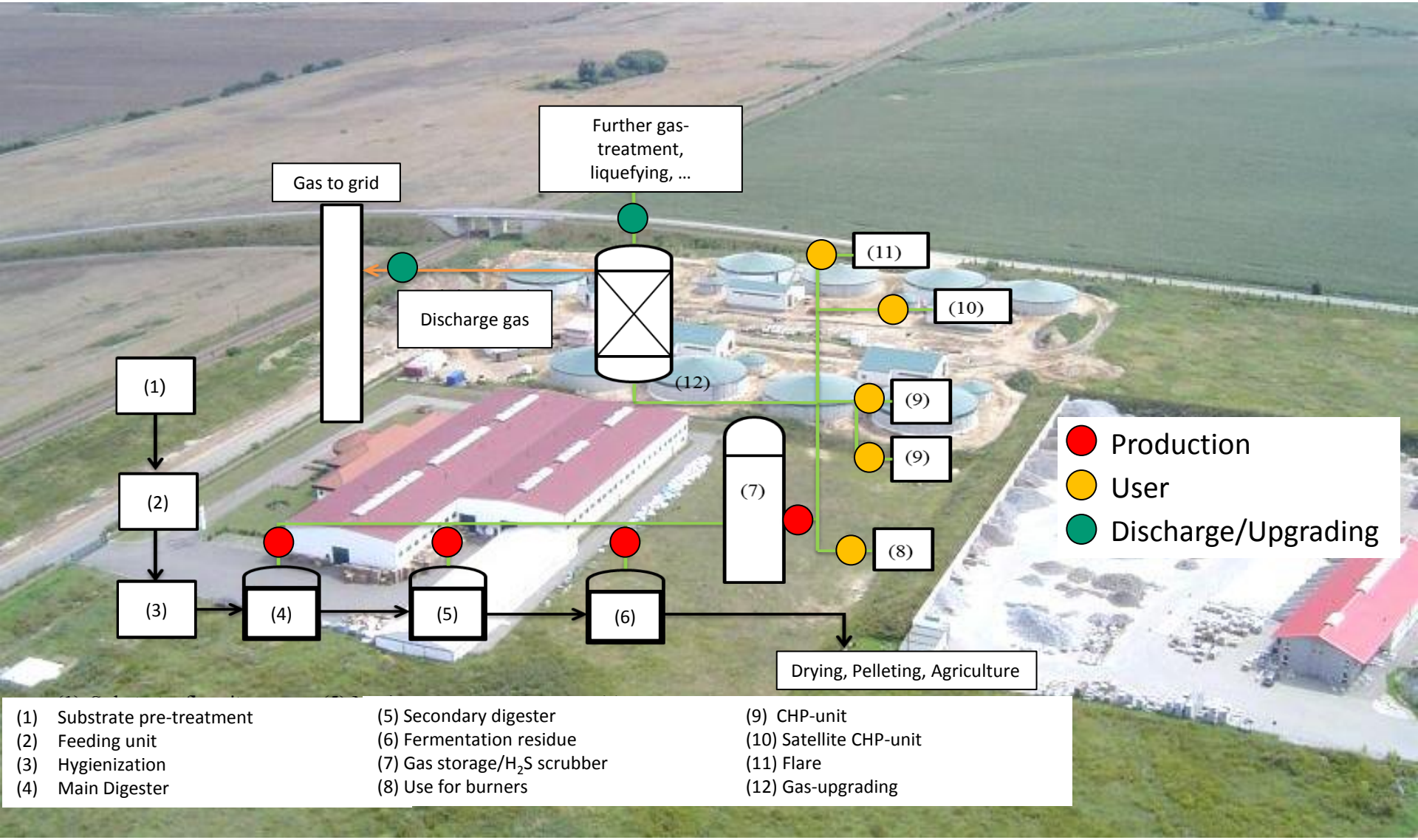
→ ***Increase of safety, efficiency and profitability***

Biogas particularities

BIOGAS – a mixture of different gases

	Gas component	*Description*	*Challenge*
	CH4 (Methane)	The product which we want	Maximize yield
	H2S (Hydrogen Sulfite)	The problem	Toxic and corrosive
	O2 (Oxygen)	Carefully to be watched	Avoid explosion
	CO2 (Carbon Dioxide)	Complementary to CH4	

Typical measurement locations



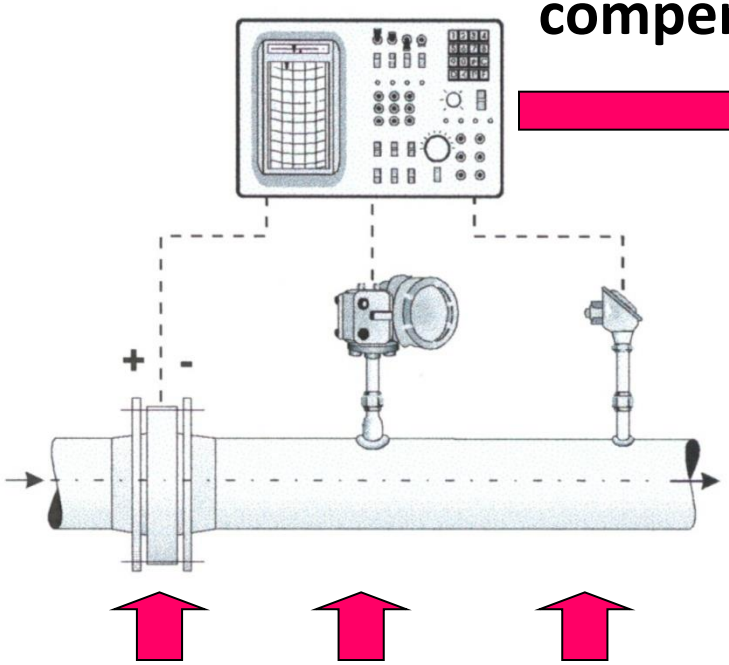
(1) Substrate pre-treatment
(2) Feeding unit
(3) Hygienization
(4) Main Digester
(5) Secondary digester
(6) Fermentation residue
(7) Gas storage/H_2S scrubber
(8) Use for burners
(9) CHP-unit
(10) Satellite CHP-unit
(11) Flare
(12) Gas-upgrading

Gas qualities on the different measuring points

Gas Production	*Gas User*	*Gas Upgrade*
dirty, wet, corrosive	Less dirty, partly dry,corrosive	Clean, dry
low pressure (-3…+3 mbar)	higher pressure (40…80 mbar)	high pressure (bar ranges)
low velocities (0,5…3m/s)	higher velocity (8…15 m/s)	high velocity
CH4 48-54 Vol.-%	CH4 48-54 Vol.-%	CH_4 95-98 Vol.-%
H_2S up to 10000 ppm	H2S < 100 ppm	H2S < 2 ppm
O_2 0-1 Vol.-%	O_2 0-1 Vol.-%	O_2 0-1 Vol.-%
CO_2 38-42 Vol.-%	CO2 38-42 Vol.-%	CO_2 2-5 Vol.-%

Definition Standard-Cubic-Meter

Measuring volumetric flow



Volume Pressure Temperature

Biogas: ***+ Humidity + Gas-Composition***

compensation

Standard Volume V_0

Gas Mass m

p & T compensation necessary for:

- Orifice plates DP
- Vortex flow meter
- Turbine meters/ mechanical counters
- Ultrasonic flow meter
- Pitot tubes
- ...

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Technologies for
Flow & Analyze of
Biogas

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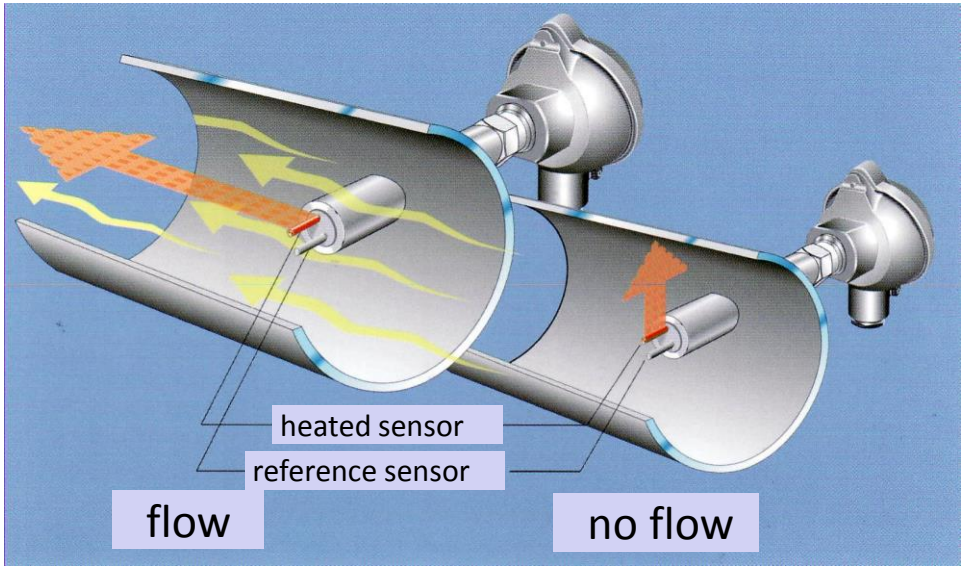
COMBIMASS® - thermal gas flow measurement

COMBIMASS® Thermal dispersion mass flow measurement



Temperature:

Sensors measure resistance (by use of Pt100 sensors) – second sensor provides as reference

Principle:

Dispersed heat provides as reference for the amount of gas-molecules passing by → direct mass-flow measurement

Advantages:

Unaffected by pressure and temperature changes, very low pressure drop, precise even at low flow rates, reference sensor can be used to provide the gas temperature.

Challenge:

A CH_4-molecule disperse a different amount of heat than a CO_2-molecule etc. Also water damp molecules disperse heat.

BINDER Gas analysis

Analyzer station ***COMBIMASS® GA-s Hybrid***

The New flexible modular analyzer system:

- flexibility in cabinet sizes & material
- flexibility in size of graphic display
- flexibility in gas cells
- flexible for indoors/outdoors
- flexible in sampling frequency and sequence (continuously/ frequently)
- **Easy assembly and maintenance**

Modular System for specific customer's requirement

Energy Measurement

Denmark – Energy Measurement

Tax options for biogas plants

- Based on energy measurement
- Based on max. possible output

→ Energy measurement is clearly in favor

But: whole measurement must be ***better than 3% accurate***

GA-s hybrid for energy measurement

- One single sampling point in combination with one CH4 gas module
- Implementation of thermal dispersion gas flow meter (with integrated humidity correction for the measurement of dry biogas flow), Automatic correction for actual gas composition
- Automatic correction of gas composition based on ambient atmospheric pressure and gas temperature
- **Calculation of energy contents** in the gas based on gas flow and gas composition with an overall **accuracy of better than 3%**
- Various alarm settings and transfer to the PLC possible, direct wiring via Ethernet, external access as well as data transmission/”life-bit” function via GSM/GPRS
- Auto-calibration function
- Gas feed-back from analyzer into the gas pipe possible

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GA-s hybrid for energy measurement

…see the real product on the exhibition table

Conclusions

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Conclusion

- Importance of Plant Monitoring
- Suitable solution for particular requirements
- Maintenance made easy

→ ***stable***, ***safe*** and ***profitable*** operations

Contact

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Visit the booth
outside in the hall