



Biogas Monitoring – „Why and How?“

Michael Krafzig, Division Manager Biogas Binder GmbH



BINDER

Binder Group AG Finance Holding



Binder Engineering & Instrumentation - Sales & Service Companies in DE / CH / NL / BE / China, Singapore, Malaysia



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



INSTRUM AG Manufacturing Company for Stainless Steel Pressure Regulators and Valves

INSTRUM AG 不锈钢压力调节器和阀门制造公司



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

BETA B.V. 压力和温度开关制造公司



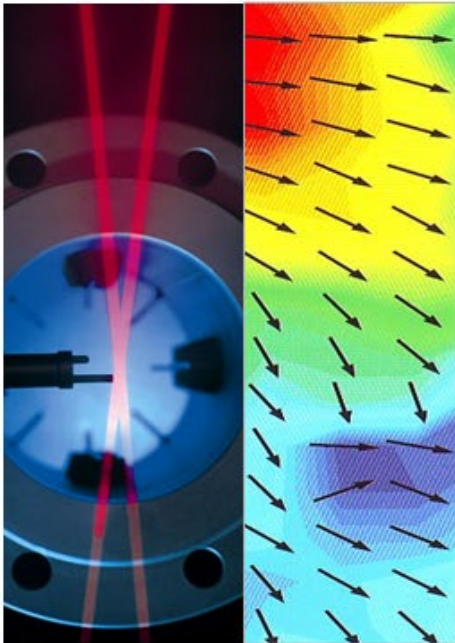
www.bindergroup.info

BINDER

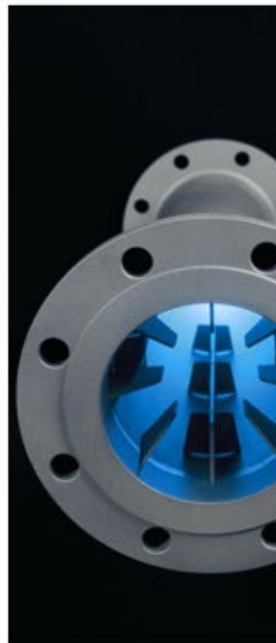
Introduction

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

Real Gas Flow Calibration



Gas Flow Conditioning



Gas Flow Measurement



Gas Flow Control

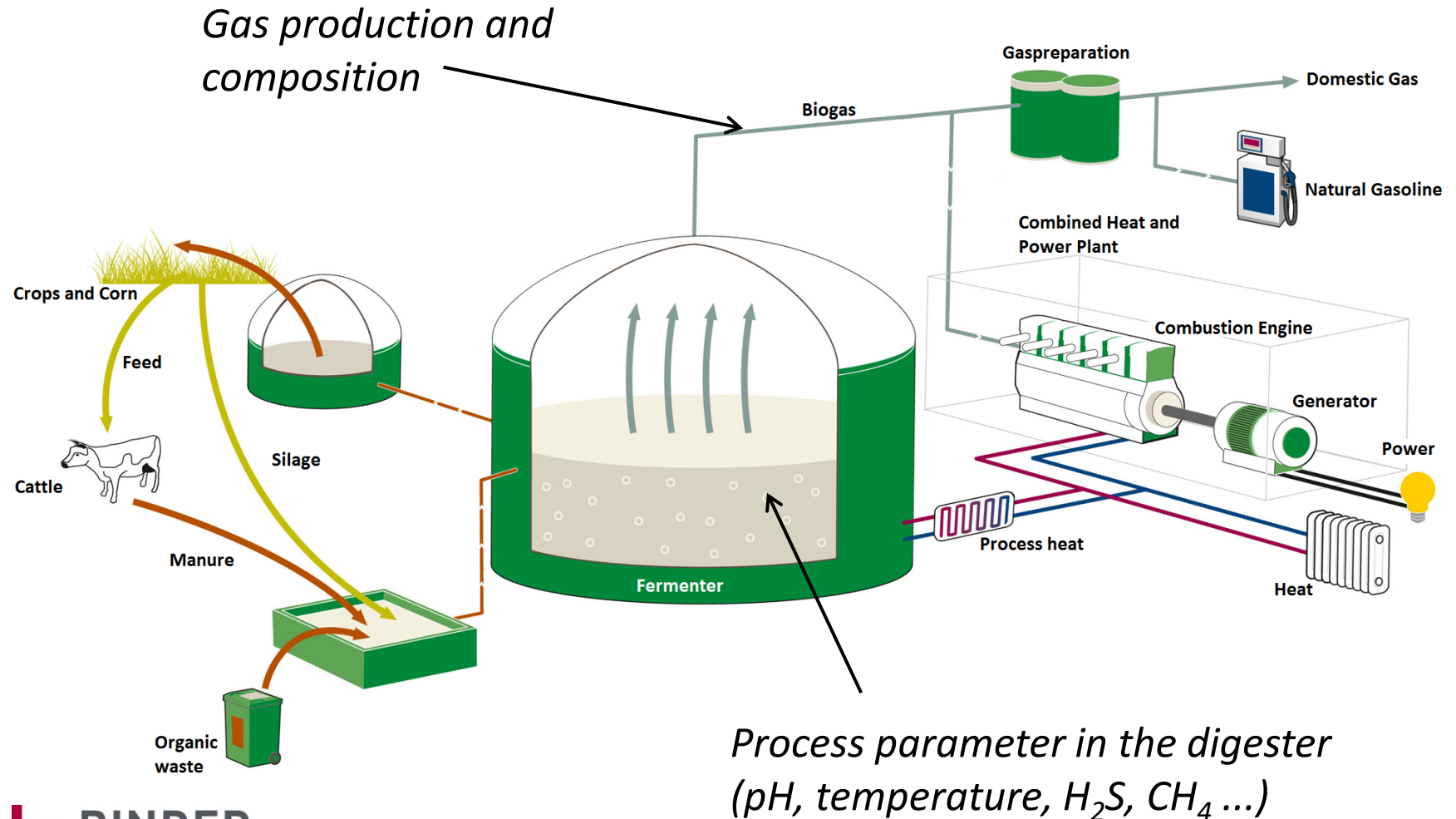


BINDER

Why is it necessary to monitor biogas plants?



Parameters to be monitored in a biogas plant



BINDER

Equipment used for treatment and utilization of the biogas

- H₂S scrubber / biofilter
- Blowers or compressors
- Biogas engine (CHP unit)
- Biogas upgrade technology (Membrane, ...)

☞ Typically these all are sophisticated and rather expensive devices!

When monitoring of biogas becomes essential

- Performance of H₂S scrubbers:
 - ☞ control operation of H₂S-scrubber according to cleaning performance or oxygen concentration in the biogas downstream to the filter

- Control and adjustment of CHP units:
 - ☞ adjust engine parameters according to changing CH₄- concentration

- Grid injection or other further use:
 - ☞ monitor gas quality (composition) and quantity

BINDER



Example: Monitoring of H₂S-concentration

- H₂S filter shall clean the gas to a suitable concentration for downstream equipment
- Performance of the H₂S-filter depends on its principle and handling
- H₂S-concentration at scrubber output must be monitored!
 - ☞ scrubber performance check
 - ☞ protect the gas-using equipment, e.g. CHP engine



BINDER

Cost - CHP engine repair vs. use of 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: 1,500 EUR / year
<i>Total: 21,000 – 60,000 EUR per case</i>	<i>Total: 15.000 – 20.000 EUR in 5 years</i>
👉 Thread: bankruptcy of plant operator	<u>Additional benefit:</u> use measured parameter to operate the plant more efficient and economic
	

BINDER

Why is process monitoring necessary?

- **Supervision** of individual components, e.g. H₂S 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 volumes and gas-quality

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

BINDER

Biogas particularities



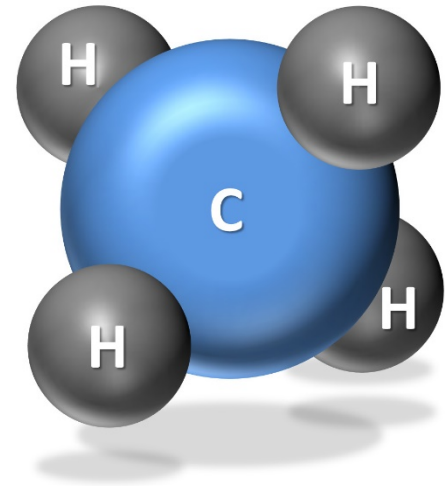
BINDER

CH₄ - methane

Methane – this is the product we want!

It is therefore essential, that your plant maximizes the percentage of CH₄ produced. It is a good practice to measure, record and monitor the quantity (gas flow rate) and quality (composition) of the biogas being generated.

☞ a clear indication of the yield of your plant (outcome per tonne of used feedstock) !



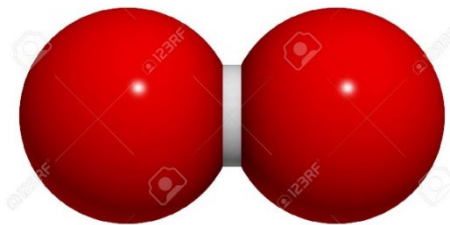
BINDER

O₂ - oxygen

Oxygen - this is a critical process indicator!

You have to ensure that you are not producing an inefficient or explosive mixture of methane and oxygen.

☞ Increased oxygen levels could indicate performance issues leading to a decrease in microbial activity (poisoning) in the anaerobic digester or leaks into the system, both affecting productivity and safe operation of the plant!



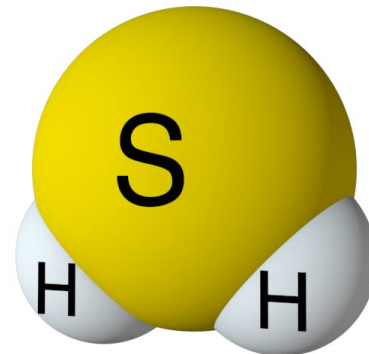
BINDER

H₂S – hydrogen sulphide

Hydrogen sulphide - this is a highly toxic and corrosive gas!

It is essential to monitor the concentration. High levels of H₂S must be prevented, as it is corrosive to engines and can condense and form sulphuric acid within the process, resulting in large operational and maintenance costs. Most engines typically require less than 200 ppm H₂S. But as the concentration can often rise well above this, it is important to know when this is occurring so appropriate steps can be taken.

☞ Feeding of gas into a network grid has more stringent requirements!



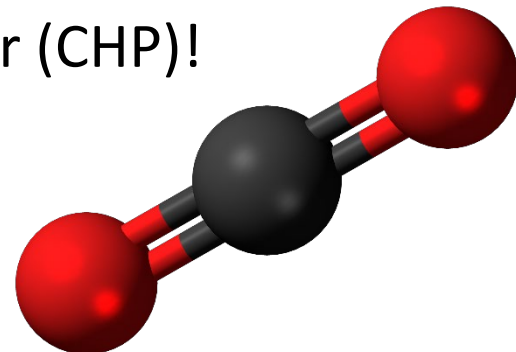
BINDER

CO₂ – carbon dioxide

Carbon Dioxide – the “useless” but also toxic component!

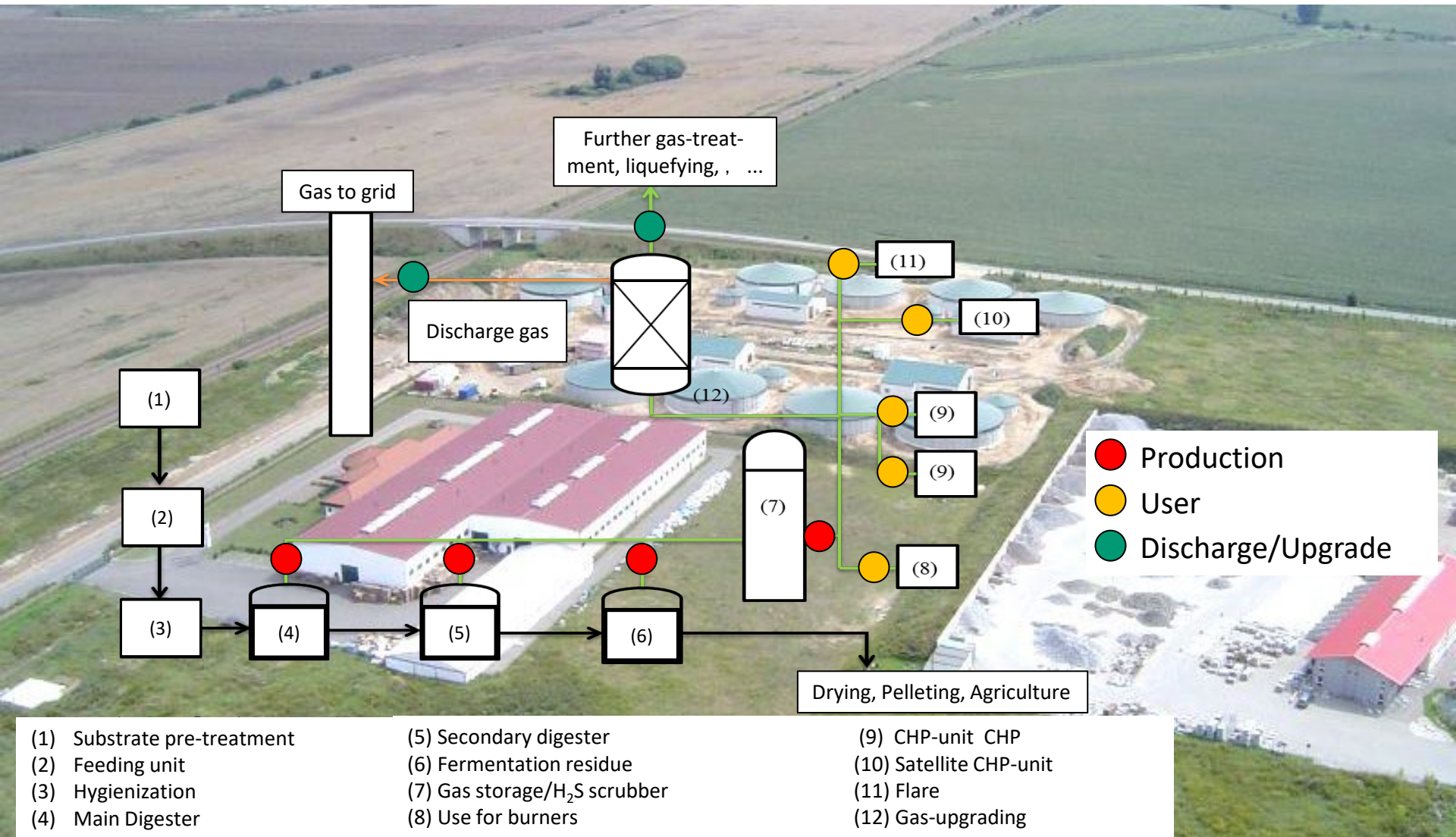
In a similar way to the measurement of the oxygen levels present, the carbon dioxide concentration is a good indicator of the performance of the plant, ensuring that the anaerobic digester is operating efficiently.

- 👉 Rising CO₂ levels would indicate a drop in quality of the fuel being supplied to the combined heat and power generator (CHP)!



BINDER

Typical measuring locations



BINDER

Gas qualities on the different measuring points

Gas Production:

At the digester, after gas-cooler, after gas-storage, in front of the H₂S-scrubber/filter
dirty, wet, corrosive, **low pressure (-3...+3 mbar), low velocities (0,5...3m/s)**

Gas-Use:

After H₂S-scrubber/filter, in front of the CHP-unit, in front of the flare, in front of the
burner/boiler less dirty, partly dry, still corrosive, **higher pressure (40...80 mbar), higher
velocity (8...15 m/s)**

CH₄ 48-54 Vol.-%, CO₂ 38-42 Vol.-%, O₂ 0-1 Vol.-%, N₂ 0-5 Vol.-%, H₂S < 100 ppm, H₂O-
vapour < 1 Vol.-%

Upgrade and discharge:

After bio-methanization plant, in front of the feed-in point to the gas grid clean, dry, **high
pressure (bar ranges), high velocity**

CH₄ 95-98 Vol.-%, CO₂ 2-5 Vol.-%, H₂S < 2 ppm

BINDER

Technologies for
biogas flow
metering & analysis



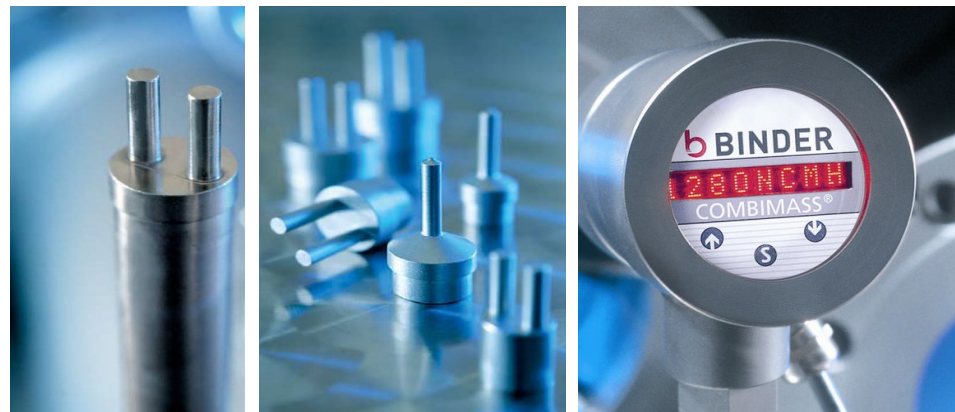
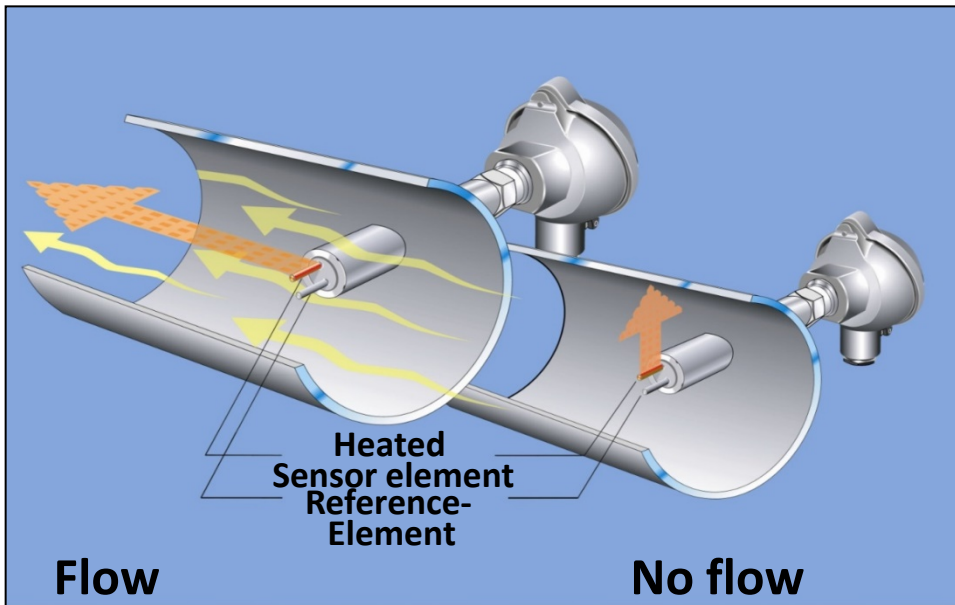
BINDER

COMBIMASS® - thermal gas flow measurement



BINDER

COMBIMASS[®] Thermal dispersion mass flow measurement



Temperature:

Sensors measure resistance (by use of Pt100 sensors) – second sensor provides as a 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 CH₄-molecule disperse a different amount of heat than a CO₂-molecule etc. Also water damp molecules disperse heat.

Analyzer systems of COMBIMASS[®] series



- mobile analyzer type GA-m with ATEX- approval for biogas, digester gas and landfill gas
- completely modular analyzer station GA-s hybrid:
 - simple and standardized OEM-design hybrid eco with fixed configuration
 - variable with the hybrid premium
 - with application-specific gas modules hybrid syngas

Analyzer station of COMBIMASS® GA-s hybrid series

Complete modular set up:

- flexible in cabinet size (300x400, 400x400,..., 1.000x1.000,...) and material (plastic, stainless steel, ...)
- flexible size of graphic displays (4.3" , 7.0")
- flexible in the assembly of different gas modules
- flexible in place of installation (indoor/ outdoor)
- flexible in terms of measuring frequency (contin./ at fixed intervals)
- easy commissioning and maintenance (diagnosis)



Maintenance analyzer stations hybrid series

Maintenance: is work that is carried out to preserve an asset, in order to enable its continued use and function above a minimum acceptable level of performance over its design service life, without unforeseen renewal or major repair activities.

- support the business continuity in the most efficient manner
- ensure the asset is design and operated correctly to its intended purpose
- prolong the assets life
- maximize equipment capability from the original design
- improve the asset performance
- ensure quality of production/service delivered in timely manner
- take responsible care in Safety health and environment
- comply to regulatory requirements and accreditation needs

BINDER

Hybrid maintenance is made smart & easy

As Gas Analysers are essential for monitoring the process in your biogas plant, it is imperative to maintain this equipment.

- eliminate the tedious task of exchanging cells by using modular cells (no special skills of technicians at site is required to replace a hybrid module, pump, valve)
- providing optional auto calibration to dispense with the need for on-site or off-site calibration
- Ethernet/Internet remote control, trouble-shooting and diagnostic assessment
- calibration and maintenance with local service back-up and on site recalibration possibility

☞ Any downtime will put your plant at risks!

BINDER

Conclusions



BINDER

Conclusions

- importance of plant monitoring
- suitable solution for particular requirements
- maintenance can be done easily

☞ ***stable, safe*** and ***profitable*** operation of your biogas plant!



We are happy to receive your feedback, questions and remarks!

Michael Krafzig
Division Manager Biogas

Michael.Krafzig@bindergroup.info
+49 174 3364353

Binder GmbH
Buchbrunnenweg 18
89081 Ulm, Germany