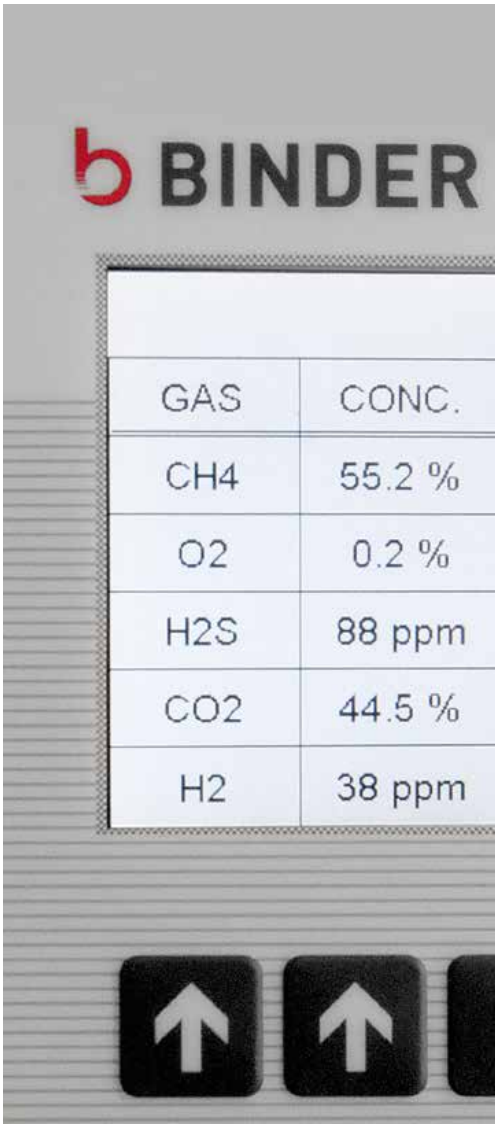
COMBIMASS®

Gas analysis and gas flow measurement systems for portable and stationary operation

For the qualitative and quantitative analysis of biogas, digester gas, landfill gas, air and exhaust air



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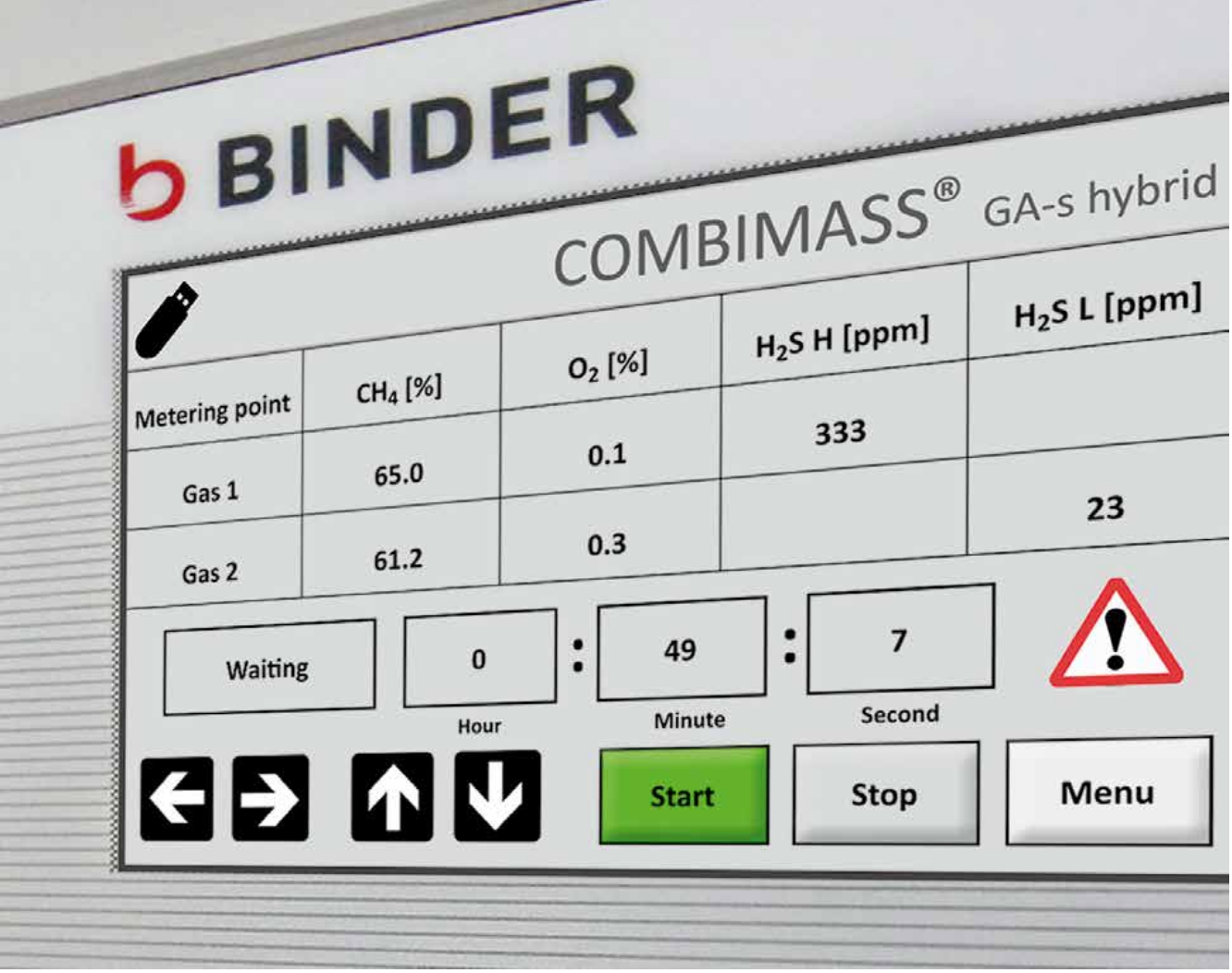

Gas analysis and gas flow measurement

Today, modern plants for the production, refinement and utilization of biogas or syngas contain costly and rather sensitive maintenance-intensive components and parts. The protection of this equipment is therefore of particular importance in order to reduce unexpected downtimes and repair costs.

The profitability of a plant is essentially determined by intelligent process monitoring and control. In addition to the process parameters in the reactors, a reliable and precise measurement of the gas production and quality is required for a safe operation of the cogenerators.

In exhaust air, typical gas compositions are measured in minute concentrations. The focus is on reducing emissions of environmentally harmful gases, while economic efficiency plays only a minor role.

For all these tasks, Binder offers with the products of the **COMBIMASS®** series various instrumentation solutions adapted to the application.


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Typical applications for gas analysis and gas flow measurement

For more than two decades Binder has been supplying innovative systems for gas flow measurement worldwide. Biogas applications have gained significantly in importance over the last fifteen years. Measurements in humid, corrosive and dirty biogas with fluctuating gas composition or in exhaust air with small concentrations create special demands on the selected sensors with regard to resistance, accuracy and durability.

The gas composition in agricultural biogas plants varies depending on the process and composition of feedstock. Biogas quantity and quality are measured after the individual fermenters, at the flare, are used for filter monitoring in gas purification and before consumers such as boiler and CHP. Another application is monitoring the quality of the supplementary air from the double membranes of the fermenter covers.

In sewage treatment plants, the gas quality is only subject to minor fluctuations. The quality of the digester gas after the H_2S filter is monitored in addition to the flow rate. It can be safely decided when the filter material should be replaced instead of replacing it at fixed times.

Exhaust air from covered tanks and closed rooms with screening or sludge thickening equipment can be measured and analyzed prior to the treatment in scrubbers or filters.

In waste treatment plants solid biomasses are decomposed in dry fermenters and converted into high quality compost. Since the process is realized in batch operation, the amount of biogas produced and the gas quality change significantly over the cycle time.

In gasification, syngas is analyzed for process monitoring and CHP protection. Process conditions must be stable to prevent formation of tar.

At landfills, analytical technology is used for long term monitoring of individual fields or for monitoring the landfill gas quality in the collection pipeline.

The direct link between flow rate measurement and gas analysis brings great advantages: Always most accurate quantity measurement, even under changing conditions with regard to moisture and gas and useful additional functions by linking the data from both systems.

The components of the modular concept

- **COMBIMASS® eco-bio+** for biogas: Thermal gas mass flow meter, version SS ATEX certified or AL for Ex-Zone 2, options: integrated humidity correction, tamperproof versions
- **COMBIMASS® eco** for sewage and landfill gas: Thermal gas mass flow meter, for operation in Ex-zones, option: integrated humidity correction
- **COMBIMASS® syngas**: Thermal gas mass flow meter in coupling with a thermal conductivity sensor as flanged instrument, with H_2-compensation, for operation in Ex-zone 2
- **COMBIMASS® OEIN hot tapping unit:** For easy installation/removal of sensors for maintenance purposes
- **COMBIMASS® flow conditioner**: To improve the measuring accuracy in case of unfavorable pipe routing
- **COMBIMASS® GA-m**: Mobile gas analyzer for biogas and synthesis gas, with battery and data logger
- **COMBIMASS® GA-m air check**: Mobile analyzer for air in rooms with increased CO_2 content or exhaust air
- **COMBIMASS® GA-s hybrid eco**: Compact, cost effective and standardized analysis station for one to three gases
- **COMBIMASS® GA-s hybrid premium**: Individual, modular and multifunctional analysis station
- **COMBIMASS® GA-s hybrid syngas**: Modular analysis station for synthesis gas
- **COMBIMASS® GA-s hybrid air monitoring**: Compact and standardized analysis station for monitoring of air and exhaust air

COMBIMASS® Gas flow meter

The measuring systems of the **COMBIMASS®** series are field transmitters for flow measurement of gases for a wide range of different applications, also in different explosion-proof versions.

The sensor head is milled from a single block of high-grade stainless steel and therefore resistant to corrosion. The measured values are transmitted via 4–20 mA or Modbus. Besides the gas quantity, the gas temperature and a counting pulse can be transmitted. The values can be read on the integrated display with control panel or on a graphic display in a separate field housing.

Before delivery, each system is calibrated in our **CAMASS® Calibration Lab** with consideration of the real operating conditions with regard to gas composition and the installation situation and then delivered as a plug-and-play device.

All **COMBIMASS®** sensors use the thermal measurement principle. They measure the gas mass or volumetric flow at standard pressure and temperature (acc. to DIN 1343: 0 °C, 1.01325 bar, 0 % rel. humidity).

Biogas, digester gas and exhaust air are usually wet gases where the moisture content is inherently measured as well. Hence, the standard volumetric flow rate cannot be directly determined. In such cases of moisture saturation, the moisture in the gas is calculated based on the gas temperature and directly compensated in the sensor.

Thermal dispersion technology is particularly well suited compared to all other measuring methods because thermal sensors measure with high precision even at low gas velocities and pressures. A further significant advantage is that no additional sensors are required for pressure and temperature compensation. This allows for example the use of **COMBIMASS® eco-bio+** for the verification of the amount of raw biogas produced annually, e. g. for CDM-projects. For this verification, further special low-tampering versions are available.

COMBIMASS® eco-bio+ for biogas
Compact insertion sensor for easy installation in Ex-zone 1 or 2, sensor made of stainless steel 316 TI (1.4571), with a rugged design, corrosion-resistant and wear-free, high accuracy even at lowest speeds and gas pressures.

- Measurement locations: for wet biogas directly after the digester, the gas cooler, the desulphurizer or in front of the CHP
- With directly integrated humidity correction to determine dry gas quantity in standard cubic meters acc. to DIN 1343 (option)
- In manipulation-protected design with local display as **eco-bio+ SS HA MS** (option)
- With hot tapping unit and additional T-piece and valve for gas sampling to analyzer (option)

COMBIMASS® eco for digester gas, landfill gas and exhaust air
Compact insertion sensor with a clamping ring screw connection in full stainless steel design for zone 0, 1 or 2, rugged design, corrosion-resistant and wear-free

- Suitable for all measurement locations – from gas production to consumption with high accuracy
- With integrated or separate display
- With adapted calibration range and calibration reserve
- Options: with directly integrated humidity correction to determine the dry gas quantity in standard cubic meters according to DIN 1343, hot tapping unit and additional valve for gas sampling to the gas analyzer, data transmission via Modbus RTU or 4–20 mA HART, with data logger for data storage, with manual or automated cleaning system for the sensor in extreme installation locations

COMBIMASS® flow conditioner
The **COMBIMASS® flow conditioners** are used for difficult pipeline configurations, after bends, cross-section changes, fittings or pulsating compressors. They smooth the flow profile, almost without pressure loss, ensuring reproducible conditions at the measuring location.

Guaranteed precision for COMBIMASS®
When using technically highly developed systems for measuring and controlling gases, calibration becomes the key factor for success. To ensure maximum measuring accuracy, every **COMBIMASS®** measuring device or system is calibrated precisely in the **CAMASS® Calibration Lab** with simulation of the actual operating conditions.

For difficult applications, even the corresponding pipe run (up to nominal diameter DN 500) can be replicated if necessary. In this way, every effect of flow on the measurement caused by the pipeline and the configuration can be recorded and compensated.

COMBIMASS® Gas analysis

Various measuring methods are available in the **COMBIMASS®** gas analysis instruments and systems. Besides the typical infrared method, electrochemical, paramagnetic and thermal conductivity sensors are used to determine the gas composition. All values are pressure and temperature compensated, in order to achieve a high accuracy. A manual or automated calibration enables a very good long-term stability of the measured values.

All devices and stations are modular and can be extended if necessary. Each system is checked and calibrated in our **CAMASS® Calibration Lab** before delivery. All analyzers are designed to make services easy. The integrated maintenance diagnosis function monitors the measuring cells and signals wear. The operator or a service company can exchange the parts according to actual needs. The following technical solutions are available:

Mobile analysis with COMBIMASS® GA-m
Measurement of up to seven gas components using optical infrared analysis and long-life electro-chemical cells, with a powerful sample pump and data logging according to sampling sites for

- various biogas applications
- exhaust air applications
- measuring air, to find hidden people and animals and
- the analysis of synthesis gas

Stationary analysis of biogas with COMBIMASS® GA-s hybrid eco
Compact multi-component gas analysis station with an assembly of one to three gas components for a maximum of two gas flows, suitable for OEM customers to solve standard measuring tasks such as filter monitoring or measurement in front of the CHP

- Alarm triggering on exceeding or falling below thresholds
- Data transmission to the plant´s control system via standard interfaces (analog signal 4–20 mA, Modbus RTU)
- Free analog inputs for connection of gas flow meter of **COMBIMASS®** series

Stationary analysis of biogas with COMBIMASS® GA-s hybrid premium
Individual multicomponent gas analysis station, consisting of standardized modules as a modular concept

- Individual gas sensors, mounted in sensor modules on top-hat rails, allow customized systems
- Various housings for indoor or outdoor operation, for cyclic or continuous analysis
- With a PLC to control the pumps and valves, alarm management, maintenance analysis and diagnosis, automatic gas composition correction of gas flow signals etc.
- 4.3“ or 7“ graphic display with multilingual menu navigation and operation via touch screen
- Transmission of data and alarms to the plant´s control system via standard interfaces
- Accessories: Components for gas conditioning, flame arrester, gas cooler
- Many further options: internal data storage, remote dial-in for maintenance diagnosis via secure Internet or GSM/GPRS

Stationary synthesis gas analysis with COMBIMASS® GA-s hybrid syngas
Standardized multicomponent gasanalyzer station specially developed for gases from solid gasification plants

- contains all hardware components of the **premium** series
- with special process adapted gas modules for high H_2 and CO concentrations (thermal conductivity)

Stationary air analysis with COMBIMASS® GA-s air monitoring
Standardized multicomponent gas analysis station specially developed for monitoring the air of double-walled membrane foil roofs or exhaust air from covered tanks and rooms

- contains all hardware components of the premium series
- with special process adapted gas modules and measuring programs for CH_4 concentrations in the ppm range, H_2S in different measuring ranges, also with HIGH/LOW switching

CAMASS®
Calibration technology for gas flow

Calibration is an important factor for success when using technologically advanced systems for measuring and controlling gases. In order to ensure the very highest measurement and control precision, each **COMBIMASS®** system is precisely calibrated in the **CAMASS® Calibration Lab**, using real operating conditions.

In contrast to liquid media, the properties of flowing gases depend much more on operating conditions, gas composition and the actual flow conditions in the pipeline. If such parameters are not taken into account, considerable limitations must be expected regarding the accuracy of measurements.

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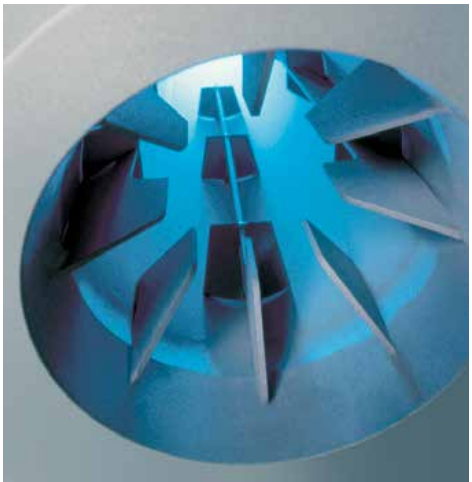
In order to guarantee the precision of the measurement and control systems, the pressure, temperature and loading conditions which will later occur in the customer's plant are simulated exactly using the appropriate gas mixture.

For difficult applications, even the corresponding pipeline configuration (up to nominal diameter DN 500) can be replicated exactly if necessary. In this way, every effect of flow on the measurement caused by the pipeline and the configuration can be recorded and compensated for.

COMBIMASS® flow conditioner
The COMBIMASS® flow conditioners are used for difficult pipeline configurations, after bends, cross-section changes, fittings or pulsating compressors. They smooth the flow profile, almost without pressure loss, ensuring reproducible conditions at the measuring location.

COMBIMASS® flow conditioners reduce the inlet and outflow straight pipe length for measurements to three to seven times of the pipe diameter. They are rugged, dirt resistant and guarantee best measurement accuracy.



Application biogas and solid waste treatment

Modern biogas systems can hardly be operated in a cost-effective and environmentally friendly way without appropriate measurement and analysis technology. Today, monitoring of the concentration of sulphur and methane when using the gas is of special importance, since these essentially influence the function, maintenance cycles and efficiency of the CHP.

COMBIMASS® analysis technology is used:

- To measure the gas composition in the individual fermenters, to calculate the gas yield from the amount of feedstock, to manage the filling level of gas and to optimize feeding cycles
- In monitoring the H_2S concentration after the filter in gas purification plants
- For monitoring the gas quality in front of the CHP
- For monitoring the individual process stages in biomethane plants
- To determine the energy content in the biogas flow when selling gas or feeding it into local micro grids
- For leakage monitoring of the membrane roofs

The biogas after the fermenter is particularly wet, usually even saturated with water vapor. For process optimization it is therefore advisable to install a **COMBIMASS® eco-bio+** flow meter with integrated moisture compensation after each digester to determine the dry biogas quantity at standard conditions. Only these values at standard conditions can be compared.

However, if the gas composition changes more, as for example in dry fermentation/solid waste treatment plants, a correction of the gas volume signal of each digester box based on the current gas composition may be useful.

Biowaste treatment plants are often built at landfill sites. There, predominantly solid household waste as well as green waste and other biodegradable residues are treated biologically. In addition to the use of gas in CHPs, a high-quality end product is produced, which can generate further revenues as compost. Filters installed upstream of the analysis station can remove components from the gas which could lead to a fall-off in the measured values.

During filling and emptying processes, especially the oxygen and H_2S concentrations in the opened boxes must be measured and monitored if safety aspects or personal protection are to be considered. An alarm is integrated as standard if limit values are exceeded.

Availability and accuracy of the measured values have a high priority. Therefore, the gas modules are typically recalibrated automatically at fixed intervals and a second set of gas modules enables regular operation within a few minutes in case of replacement.

Unrestricted design freedom with COMBIMASS® GA-s hybrid

The analyzer stations of the **COMBIMASS® GA-s hybrid** series are completely modular, with application-specific gas modules, pumps, valves, gas coolers and other durable components.

The visualization of data, overload protection of the gas cells, alarming of the operator in case of exceeding or falling below threshold values, displaying required maintenance, automatic calibration of the gas cells during operation or recalibration of the gas modules on site and easy exchange of all spare and wear parts by a service company or the operator guarantee high operational safety, always accurate measured values and low maintenance costs.

- **COMBIMASS® GA-s hybrid eco**:
  For H_2S filter monitoring, for monitoring the CH_4 concentration upstream of the CHP or as a combination of both – this low-cost version offers standardized basic concepts based on a simple control system

- **COMBIMASS® GA-s hybrid premium**:
  Analysis station with flexible measuring program, PLC and graphic display, for complex measuring tasks with several gas circuits, remote dial-in and data transmission

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Manifold applications

Dry fermentation and mechanical-biological solid waste treatment

- A dozen measuring points for gas quantity and quality? No problem thanks to the unlimited scalability of the COMBIMASS® module concept
- Best accuracy of gas volume measurement even with strongly fluctuating gas composition thanks to automatic signal compensation
- Parallel gas circuits and redundant gas modules increase operational safety and availability

Desulphurization – Filter monitoring

Process monitoring during the removal of sulphur from the raw biogas, control of the air flow rate via the H_2S inlet concentration, design with two gas modules with different measuring ranges for the exact determination of the small concentration in the filter or after the filter, with integrated overload protection of the gas modules and continuous oxygen monitoring in the gas after the filter – all this solves every measuring task optimally.

Biomethane

Process monitoring for the removal of sulphur, carbon dioxide and residual moisture from raw biogas, continuous gas analysis, accurate measurement of very low H_2S concentrations in the biomethane and of low CH_4 concentrations in the exhaust gas flow – thanks to high-quality measuring cells, adapted measuring ranges and auto-calibration of the gas modules with different test gases – also available with long-term stability. Replacement modules on site guarantee replacement within a few minutes.

Energy calculation for gas sales

The combination of continuous CH_4 analysis with auto-calibration and a high-precision calibrated gas flow meter, installed in a supplied measuring pipe section, allows the exact calculation of the energy content of better than 3 %. Redundant essential components, an independent power supply, plausibility checks of the measured values and encrypted data transfer to a central server increase the operational safety and prevent manipulation.

Air monitoring of membrane roofs

An analysis station with specially developed gas modules and measuring methods is used to monitor the tightness of the membrane by analyzing the supporting air to meet the safety requirements for biogas plants and reduce gas losses.

Detection devices for authorities / CDM-projects

Special manipulation-protected device versions are accepted by many authorities as proof of the annually produced raw biogas quantity.

Application sewage treatment plant

In contrast to biogas systems, the livelihood of a sewage treatment plant does not directly depend on the cost effectiveness of gas generation. Different priorities are set here, since methane is much more climate-hazardous than carbon dioxide. The fermentation process in the digester must run controlled under exclusion of air. In the past the biogas was often burnt off in a flare. However, with current energy prices, it is essential to utilize this valuable energy source and consequently reduce the operating costs of the plant significantly.

By digesting the sludge and using the gas for energy production, it will reduce the load to the biological tanks and thus the energy consumption for aeration drops by about one third. Digestion of sludge and use of the digester gas is therefore increasingly used in medium-sized and smaller sewage treatment plants for an overall energy balance set up.

For reliable and cost-effective operation, modern gas engines for digester gas require a minimum gas quality. Environmental regulations require modern and powerful gas measuring technology with appropriate data recording. Apart from a high operational reliability and ability to communicate, a high level of cost effectiveness is also crucial. Usually stationary measurement systems with stainless steel piping are preferred. Besides the quantity of gas, it will record and document the concentration of methane, hydrogen sulphide and oxygen in the digester gas.

Special features for sewage treatment plants

Wastewater treatment plants are often operated by wastewater associations that are responsible for large areas. Besides large plants, which require the installation of stationary systems, there is also a large number of small sewage treatment plants. Here efficient portable instruments or simple designed analyzer stations with fixed measuring program are more economical.

The COMBIMASS® concept offers both – stationary and portable measurement systems for higher profitability in your sewage treatment plant

- User- and maintenance-friendly systems
- Cost-effective full maintenance at a fixed price, with replacement unit during the maintenance or repair period if desired
- Minimal training required for personnel. A consistent, ergonomic and clear operating philosophy makes extensive training unnecessary
- Remote dial-in for data transfer or maintenance diagnostics
- All gas-carrying pipes/connections can also be supplied in stainless steel on request
- Future-proof: Requirements for extended documentation and data recording can be expected. Our systems are already well prepared for this today. The data format is Excel-compatible, but can also optionally be in a largely tamper-proof binary format
- Emergency operation: The **COMBIMASS®** concept can optionally be equipped with a UPS, so that important alarm functions are guaranteed in case of power failure

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Gas
Gas
Gas


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For the highest demands

The COMBIMASS® concept is impressive in its flexibility and scalability

For a sewage treatment plant, the following design variants prove to have many advantages:

- COMBIMASS® GA-s hybrid eco:
  Modular, simple and cost-effective gas analyzer station with fixed measuring program, e.g. only for methane and/or hydrogen sulphid

- COMBIMASS® GA-s hybrid premium:
  Modular gas analysis station with flexible gas modules and flexible measuring program, e.g. also for co-fermentation plants

- COMBIMASS® GA-s air monitoring:
  Modular gas analysis station with special gas modules for analysis of exhaust air from buildings, covered basins and containers

Proven for a thousand times

The COMBIMASS® eco digester gas flow meter have proven themselves for many years in sewage treatment plants worldwide and have become the standard. The new generation additionally offers an integrated humidity correction for direct determination of the dry gas quantity in standard condition according to DIN 1343.

Application landfill

Today, hardly any new landfill sites are being created in Europe, waste separation and waste avoidance are clearly a trend. All the same, high-quality gas measurement technology is needed here, too.

During the stable, anaerobic methane phase, the landfill gas is used for energy production in CHPs. Modern gas engines require a minimum gas quality for reliable and economically efficient operation, the monitoring and recording of which are usually required by the engine manufacturer. The monitoring of motor efficiency gives early warning of damage and helps to minimize it. Taking current gas consumption and gas generation into account permits optimized performance control.

Combined systems for gas flow measurement and landfill gas analysis
In the stationary analysis station **COMBIMASS® GA-s hybrid premium**, gas consumption and gas composition are recorded, evaluated and documented. If higher-value hydrocarbons are present in the landfill gas, upstream filters help to increase the measuring accuracy. If the methane content decreases over the years of operation, the gas volume signal is automatically corrected when combined with the analysis station.

The landfill gas is captured in a large number of wells, collected in compressor stations and fed to the generator. Due to the huge area, the individual wells cannot be permanently connected and monitored in a fully automatic way. This is not reliable in operation and requires an enormous amount of effort. The monitoring of the wells can only be done in a mobile way.

For each well the gas composition is recorded and stored in the **COMBIMASS® GA-m** with measuring point identification, date and measuring time. After the tour the data is read out via USB interface.

Even in old landfills, when the landfill gas is no longer energetically used during the decaying methane phase and is only burnt in a flare, environmental protection demands a continuation of the metrological monitoring.

Application syngas

Use of the energy potential of biological wastes
A more extensive use of solid organic residues has led to a strong revival of gasification plants in recent years. There, quantity measurement and analysis serve on the one hand to monitor the process, but they can also be used in combination to calculate the energy content in synthesis gas.

The typical configuration includes a **COMBIMASS® eco** series thermal mass flow meter for each gasifier, whose signal is continuously corrected based on the current gas composition, and a measuring device for recording the gas quality in the collecting pipeline before it is use for energy purposes. The analysis station is suitable for the cyclic analysis of methane, CO, CO_2 and H_2 in synthesis gas. The CO and H_2 content have a significant influence on the calorific value and therefore must be measured accurately. For this purpose, special durable sensors were developed.

The **COMBIMASS® GA-s hybrid syngas** analysis station is completely modular. All wearing parts and gas modules are individually mounted on top hat rail plates for easy maintenance. The gas modules can be recalibrated in the station. This ensures long-term stability of the measured values. As an option to the menu-guided calibration, an auto-calibration function is also available if one or more test gas cylinders are permanently connected. Based on the traffic light system of the maintenance diagnosis, the service cycles automatically adapt to the frequency of use.


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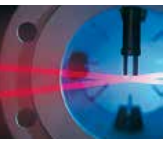
COMBIMASS®
A convincing concept

The COMBIMASS® concept is optimal if the following properties are important to you:

- Precise gas flow measurement without pressure loss even at low gas speed and flows
- Precise gas flow measurement even with variable gas composition and humidity portion
- Extremely low maintenance, corrosion resistant gas flow meter
- High-performance stationary analysis systems with highest accuracy, scalable, flow measurement and humidity compensation can be integrated, with independent data recording and various data transmission options
- Long-term accurate gas analysis via recalibration function, with full maintenance service or maintenance on real actual wear and tear, including spare units or spare modules for 100 % availability at a favorable fixed price

For all system operators with high demands who don’t have money to waste!



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