## Monitoring and control of a biogas plant **Application example**

Palm Oil Mill Effluent (POME) is liquid waste from the oil extraction process. Due to anaerobic digestion the typically open pond digester systems (lagoons) release large amounts of methane to the atmosphere and thus contribute significantly to the green house effect. POME treatment in a biogas plant with covered digester systems generates gas for combustion in genset or flares thus reducing plant methane emission.

#### UNION-analyzer used for process control and **CDM** verification

UNION Instruments installed two INCA gas analyzer at the plant: one for process control of the biogas and gas cleaning plant (MP 1-3) and another one for CH<sub>4</sub> analysis for CDM verification at the flare (MP 4). One of the analyzers was equipped with an automatic sample stream switching system to serve three measuring locations.

CDM:Clean Development Mechanism



INCA1000 dual wavelength gas analyzer for Biogas plants is especially engineered and designed for use in biogas plants. It features i.a. UNIONs unique dualwavelength NDIR mesuring technology which allows an efficient compensation of cross sensitivities and also reveal other sensor failures. Furthermore, INCA1000 uses automatic calibration with air and calibration gas.

Measuring location		Measured components	Application	Analyzer
MP 1	Outlet of lagoon A	CH4, CO2, H2, H2S, O2	Biogas plant pocess control	INCAXXXX with sample gas switching
MP 2	Outlet of lagoon B			
MP 3	After gas cleaning plant		Desulfurization plant process control	
MP 4	Base of the flare	CH₄	CDM verification	INCA1000



## User and application orientation at its best

Innovative strength, efficient and application oriented designed instrumentation and a high level of user orientation are the keys to UNION Instrument's worldwide success.

Market presence is very strong in Germany and Europe and since a couple of years also in China. Other Asian countries as well the US and Brasil are subject to intensive expansion.

Besides in the Biogas application, UNION's measuring instrumentation is used in many industries, with a focus on steel and glass, power and mining, chemical and sewage.

Operators of biogas plants are typically not very experienced in using analytical instrumentaion for process monitorimg and control. They benefit from UNION's ability to provide both required technologies (by INCA and CWD) from one hand. They also benefit from UNION's willingness to intensive application consultancy prior to any ordering decision. UNION is known for its profound knowledge in applications and corresponding instrumental solutions. That's why UNION is also known for its long lasting customer relationships.



Worldwide presence









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For any further information about our instruments, technology and application details, supporrt and training facilities: Take the opportunity to contacts us.



# **Proven leadership in Biogas Analytics**

Determination of gas composition and gas energy content for optimal plant operation



### Approved worldwide in Gas Analysis to monitor and control biogas plants

#### Over 90 years of experience and user reliance

UNION Instruments GmbH is a worldwide acting German manufacturer of instruments and systems in industrial gas measurement technology. The company has been founded in 1919 and thus looks back on over ninety years of company history, market experience and user reliance.

Today's product portfolio of UNION Instruments includes high performance gas analyzer and data logger. Gas analysis product portfolio comprises instruments and systems to determine both chemical composition (INCA product series) and thermal properties (calorimetry, energy content, **CWD** product series) of gases.

Modular design, versatile sensor technologies (optical, chemical, thermal, paramagnetic, mechanical and acoustic), suitability for indoor and outdoor installation, explosion-proof versions and sample gas switchover to operate several sampling points with one device are the keys for application-oriented solutions.

UNION's analyzer and systems are installed worldwide in many industries, with a particular focus on the bio**gas**, steel and glass industry.

#### INCA

INCA is a versatile, modular instrument for multicomponent gas analysis in the Bio- and Natural Gas industries. INCA provides an analysis system custom made for a specific application using standard modules for sample gas supply, sample gas processing and analysis, sensor control and data processing. This guarantees best possible results, optimised cost structures, short delivery times and facilitates retrofitting and/or replacement of components.

#### CWD

CWD (Calorimetry, Wobbe index, specific Density) is a modular designed instrument series for determining calorimetric values such as Wobbe index e.a. in gases. CWD is available in different variants for a wide range of applications including custody transfer measurements. CWD uses the direct Wobbe-Index determination.



Raw biogas with a high condensate content (humidity) is sampled from the digesters at separate sampling points using a sample flow switching system and sent to the INCA gas analyser. After drying in the gas cooler the composition of the two gases (up to 10 possible) is determined providing important information about the current status of the digestion process. Typical measurement components are  $CH_4$ ,  $CO_2$ ,  $O_2$ ,  $H_2S$  and  $H_2$ .

#### Transfer of raw biogas (4)

The precise determination of the energy content of the raw biogas before further processing is an important transfer function within the entire process: It enables valuating and even billing the "raw biogas" as product between different cost or operation units before further processing. Furthermore, this measurement delivers basic information to optimize the efficiency of the plant. The CWD calori**meter** is used for this application.





#### Gas conditioning (6)

In the gas conditioning process, the bio-methane is analysed regarding residual humidity, pressure, heating value / calorific value and Wobbe index. The analysis results determine whether and to what extent another conditioning (upgrading) step e.g. enrichment with LPG is required to meet the specified quality for feed-in into the natural gas network. The **CWD calorimeter** is applied for this analysis and the measured values are used to control the enrichment process.

#### Required instrumentation

As the device series INCA (gas analyser) and CWD (calorimeter) can be configured very flexibly, the measurement tasks of several sampling points can be fulfilled with just one measurement device. In general, a complete biogas plant with the 8 shown sampling points then requires 2 INCA and 2 CWD devices (one of which with special approval for custody transfer). Naturally, the demand is also influenced by the conditions of the system and the ideas of the operator.









### **UNION Instruments provides the entire solution from one hand**

From silage digestion to feed-in of biomethan to the natural gas network INCA and CWD determine gas composition and energy content (Wobbe-Index)

### Flare monitoring (2)

The content of flammable gases in the flare gas mixture is determined over a large concentration range. The objective is to ensure and control the flare function. The biogas might have to be enriched with natural gas or LPG in order to keep it flammable. The **INCA gas analyzer** is suitable to monitor this enrichment process. A gas cooler is typically required because of the high condensate content of the gas.

#### Gas cleaning (3)

The determination of the H2S concentration up- and downstream of the desulphurisation unit by the **INCA gas analyzer** with or without gas cooler is used to monitor the proper functioning of the desulphurisation process (filtration of the gas by activated carbon). The measurement shall prevent a breakthrough of unfiltered gas after saturation of the carbon. It serves as pre-indicator to enable timely switchover to a fresh filter or insertion of a fresh filling.

#### Gas processing to Bio-Methane (5)

In the gas processing plant, the gas composition is changed by different procedures in an optimising process to form "Bio-Methane". The gas concentration values up- and downstream or even directly from the process are used as control variables. Hereby, the methane emission to the atmosphere must not exceed the legally defined limit values. The INCA gas analyzer is used for both applications.

#### Bio-methane feed into the gas network (7)

Quality (and volume) of the upgraded bio-methane fed into the public natural gas network are subject to custody transfer monitoring because of the implied accounting processes. For this purpose, the energy content (together with the gas volume flow) is determined directly before the gas is supplied into the gas network. The CWD2005-CT calorimeter (Custody Transfer) is used here, which has been approved by the PTB for "custody transfer" operation. PTB: Physikalisch-Technische Bundesanstalt

#### Gas Engine monitoring (8)

Gas engines require a specific gas quality, especially in the start phase. For optimum and unjeopardised operation, the exact methane content and any traces of hydrogen sulphide  $(H_2S)$  in the biogas based combustion gas must be determined. In particular, the concentration of H<sub>2</sub>S, which is extremely harmful to the engine, must be monitored. The knowledge of the combustion gas composition is therefore also important for any possible case of warrantry. This measuring task is fulfilled by an INCA analyzer.





