

Project:

Eijbergen Netherlands

biogas plant



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and ifm sensors in
biogas plant technology

Biogas plant of Groot Zevent Vergisting BV automated with AS-interface and ifm sensors

In proportion to the green space, there are many feeding farms in the Southern areas of the Netherlands. As the green space is not sufficient for the output of organic substances such as liquid and solid manure, such manure has to be transported to other regions of the country by logistics companies to be used for other purposes. Organic substances also occur in slaughterhouses and need to be disposed of or used for another purpose. Groot Zevent Vergisting BV,



Figure 1: Delivery of organic substances

Netherlands, is such a logistics company, taking organic substances from agricultural and meat producing companies and converting them into current, thermal energy and fertilisers by means of combined heat and power generation in a biogas plant. Groot Zevent is the owner of the biogas plant described in the following, which was put into operation in the first quarter of 2005. The job for the planning and implementation of this plant was granted to the Dutch company Thecogas PlanET biogastechniek BV who implemented it together with its German affiliate PlanET Biogastechnik. For the implementation of the control and wiring concept of this plant, PlanET Biogastechnik opted for the tried-and-tested intelligent wiring (bus) system AS-interface in connection with the Profibus DP fieldbus system. All AS-interface components as well as a good portion of the position and fluid sensors were purchased from ifm electronic.

What is biogas?

All life on our planet depends on pure air and water. But the future of our civilisation also depends on energy. For this reason, we have to deal responsibly with the precious resources of this planet.

Innovative technology gives us the opportunity to solve environmental and energy issues in an efficient and economic way. One method for energy generation which is ecologically sensitive and does not affect the climate is biogas generation. Biogas is a totally natural and regenerative source of energy which consists to 50 - 70 % of methane gas.

Natural biogas occurs when organic compounds decompose under anaerobic conditions. This for example happens during the decomposition of animal and vegetable material. Anaerobic bacteria, who can also exist without oxygen, are responsible for this. The gradual process of biogas generation for example takes place in the colon of animals and humans, in swamps and moors, in paddy fields, in dung piles and cesspits or landfill sites.

Why biogas plants?

Due to the relatively high content of energy which directly depends on the methane content, biogas is an ideal carrier of energy for the generation of heat and power. If the biogas has a methane content of 60 %, the energetic value of one cubic metre of biogas is approx. six kilowatt hours. So, the average heating value of one cubic metre of biogas corresponds to approx. 0.6 litres of heating oil.

In biogas plants, the generation process described above takes place in a so-called fermenter. The produced biogas is fed to a combustion system which in return powers a generator for current generation. The waste heat which occurs in the combustion process is recirculated to the fermentation process as a necessary process heat for fermentation and can also be used internally to heat domestic buildings and stables. It can also be made available to external heat customers. The main purpose of the biogas plant, however, is the generation of current and its supply to the public network. This is done via so-called combined heat and power units (CHP). The decomposed substrate can finally be used as a high-quality secondary raw material fertiliser and fertiliser substitute for nutrient balance on acres.

So, biogas plants relieve the environment, produce regenerative energy and reprocess substrates in an environmentally friendly way.

AS-interface to reduce wiring complexity

The control technology concept of this plant is based on the intelligent wiring system AS-interface (AS-i) as an economic technical extension to the Profibus DP fieldbus system. In AS-interface, sensors as well as actuators are connected to the so-called AS-i master via a two-wire profiled yellow cable in a reverse-polarity protected way by means of field and control cabinet modules (AS-i slaves). The AS-i master integrated in a Profibus DP gateway is, together with an AS-i communication power supply, installed in a decentralised way for data collection purposes in the plant. The AS-i/Profibus DP gateway (AS-i SmartLink) in return is connected to the central controller (PLC) via a Profibus DP cable to bridge long distances. For large plants, several AS-i/Profibus DP gateways are distributed in the plant. The transmission of all system signals as well as the sensor supply are ensured via the two-wire AS-i cable. External visualisation systems such as operator panels or PC visualisation are connected to the central controller (PLC).

By using AS-interface, the wiring complexity of process plants can be reduced by up to 30 %. In addition to installation material, the workload can be considerably reduced. Moreover, the diagnostic capability is decisively increased by means of the decentralised AS-i components (AS-i slaves).

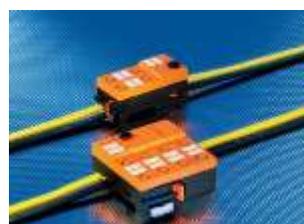


Figure 2: AS-i field modules

Why AS-interface?

On the basis of the (wiring) system AS-interface (**A**ctuator **S**ensor **I**nterface), consistent and, most of all, economical systems from the sensor/actuator to the control level are possible due to the easy system structure. AS-interface does not represent any competition to other higher-level bus systems because its structure is open to such systems. AS-i rather is an extension to the plant structure which makes sense from a technological and economic point of view. The wiring complexity alone and the associated installation time can be reduced by up to 30% using AS-i. Commissioning times are considerably minimised due to the high diagnostic capability of the system. For these reasons, it is often used in process, industrial and building system automation. With the wide range of products of many manufacturers and its comprehensive compatibility, AS-interface provides integration solutions for various sensors and actuators in almost all automation systems.



Figure 3: AS-i SmartLink

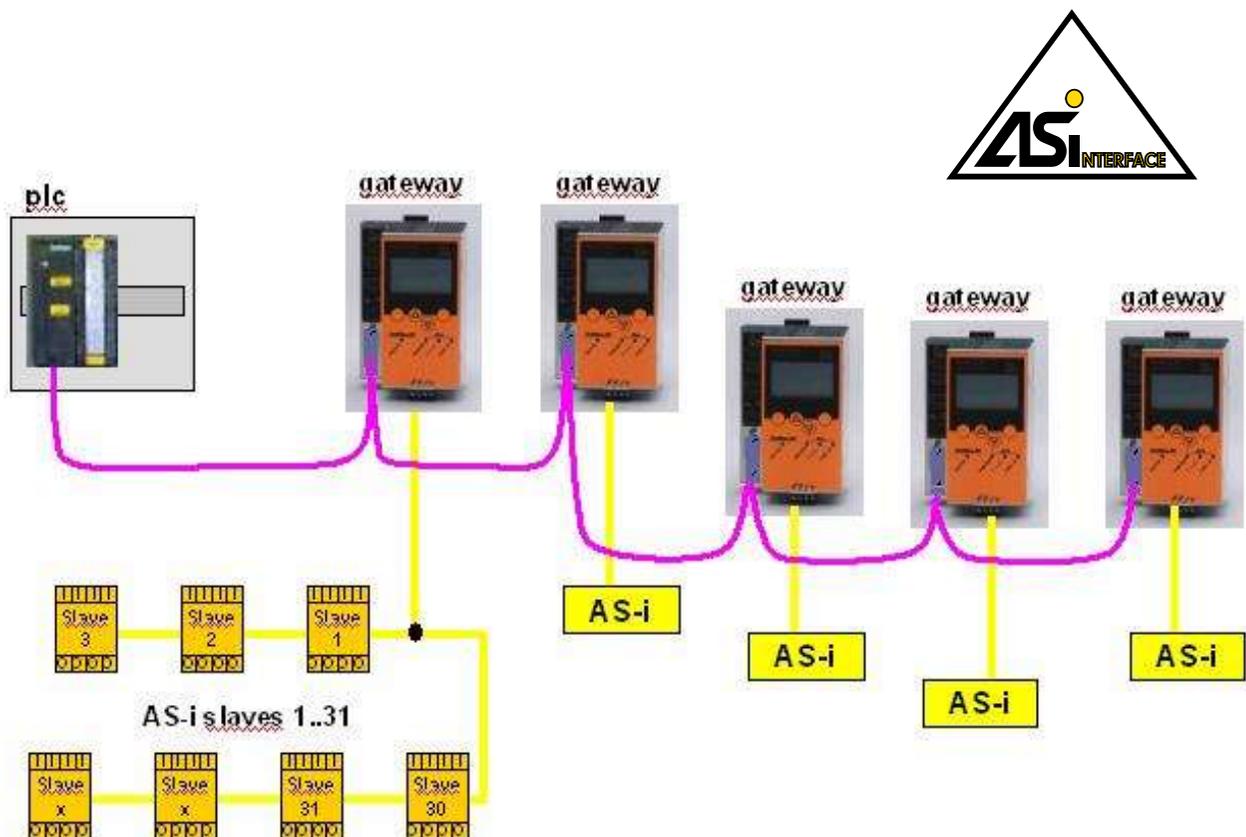
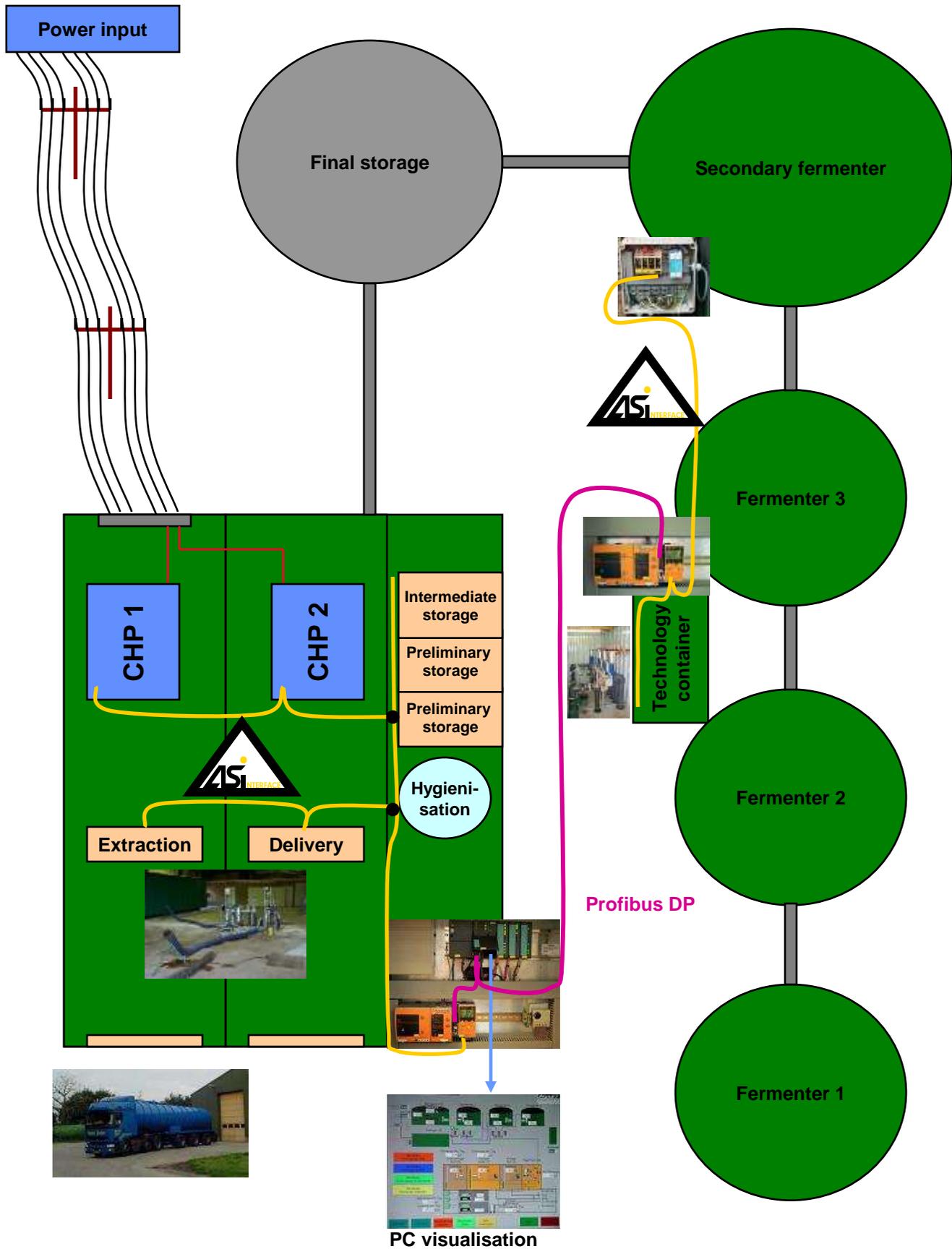


Figure 4: Structure of a complete system with central PLC, gateways and AS-i slaves in the field

Control concept with AS-interface and Profibus DP



AS-i AirBox system solution

The AS-i AirBox is used in all areas of industrial automation. AirBoxes help reduce the wiring and tubing complexity wherever compressed air is used to operate the actuators.

Tube connections are short if an AirBox is mounted close to the pneumatic actuator. This keeps pneumatic delay times to a minimum and reduces air quantities thus leading to faster processes and lower cost for the compressed air generation. All tube connections are already integrated so that time-consuming installation,



Figure 5:
AS-i AirBox in the technology container



Figure 6: AS-i AirBox in hygienisation

as in case of conventional solenoid valves, is not required. The AirBoxes incorporate industrially compatible solenoid valves with high pneumatic flow within a small space. On an area of 45x80 mm two single-acting cylinders or one double-acting cylinder can be triggered. Due to the integrated AS-i slave and the binary feedback inputs further savings as regards electrical wiring are possible.

Analogue input/output modules

Analogue input signals such as system pressures, temperatures, continuous level control etc. are detected via analogue AS-i field modules on site and are passed on to the higher-level controller for further processing via the AS-interface/Profibus DP gateway. Analogue output modules are available for triggering the actuators.

The transmission of analogue values is possible without further software as all the necessary processing is integrated in the firmware of the master.



Figure 7: AS-i UniversalLine analogue

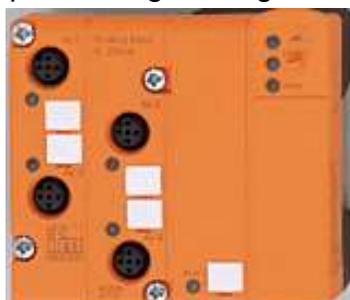


Figure 8: AS-i ClassicLine analogue module

The slaves are connected to AS-interface via the conventional flat cable lower parts (EMS) and feature protection rating IP67. The connection cables of the sensors / actuators are connected via standard M12 sockets or cage clamps. Powerful LEDs on the front panel indicate the states of the analogue channels, the voltage supply and possible faults.

Of course, analogue control cabinet modules of the SmartLine series are also available.

Easy temperature detection with AS-interface



Figure 9: Temperature sensor TS2256

The bolt-on sensor TS2229 has been especially developed for the detection of casing temperatures at machines, gears and electric motors. The eye hole enables easy mounting using an M6 screw. The use of PUR cables ensures resistance to coolants and lubricants. The sensors TS2056 and TS2256 can be used at temperatures much above 200 °C. In conjunction with the control monitor TR2432 they are a sensible combination for use in higher temperature areas.

Different requirements in a variety of process applications (here preliminary storage, hygienisation, fermenter, secondary fermenter) demand temperature sensors which differ in the required accuracy, materials used and design. Furthermore the connection to existing control monitors is as requested as the connection to PLCs or AS-i modules.



Figure 10: Temperature sensor TS2229



Figure 11: AC2520, AS-i ClassicLine Pt100 input module

The sensor TS335A has been developed according to the category 3D of the ATEX directive 94/9/EC and is therefore suitable for dust applications in zone 22. The Pt100 temperature sensors of ifm electronic mentioned above can be directly and conveniently connected to AS-i ClassicLine field modules with Pt100 inputs via M12 connectors. AS-i Universalline modules feature a vibration-resistant cage clamp fixing. In case of control cabinet wiring, different types of clamp connection via Combicon connectors can be selected.

AS-interface in the control cabinet



Figure 12: AS-i SmartLine control cabinet modules (lower row)

In control cabinets analogue as well as digital signals can be picked up and transmitted via AS-i SmartLine modules. Connection to the AS-i cable as well as to the sensors/actuators is done via conventional

Combicon connectors. So, an easy exchange of the different peripheral units is possible using Combicon connectors. The states of the digital inputs/outputs, AS-i and 24 V DC supply and possible faults at the module are displayed on the front panel by means of powerful LEDs.



Figure 13: AS-i SmartLine control cabinet modules in a field housing

Inductive end position detection of slides

Inductive sensors detect all metals without contact. Inductive sensors are indispensable today in industrial and process technological applications. As compared to mechanical switches they offer almost ideal conditions: operation without contact and wear as well as high switching frequencies and accuracy. In addition, they are insensitive to vibration, dust and moisture.



The IG series of ifm electronic is used in this application for position feedback. Standardised and easy fixing is ensured by means of the common M18 thread. The inductive sensors of ifm electronic distinguish themselves even in extreme applications by their high ingress resistance. This is evidenced by the protection ratings IP67, IP68 and IP69K by means of special units for the food and pharmaceutical industries.

Figure 14: The inductive sensor IG5595 detects the end positions of the slide without contact

Hydraulic pressure detection in a dung feeding system



Figure 15: Dung feeding system

In agriculture, organic substances and compounds are not delivered as liquid manure by truck as described above. In this case, the majority of substances is organic dung which is fed to the process via a fully automated feeding system. These feeding systems specifically tailored to biogas plants help considerably reduce the workload, smell nuisance and power requirement.

The fully automated feeding system is triggered by means of hydraulic components.

In these systems, the system pressure of the hydraulics must be constantly measured. The highly dynamic processes of oil hydraulics demand a multiple of the nominal pressure and at the same time stable measured value detection of the pressure sensors. The PA pressure sensor/transmitter fulfils all these requirements, having an analogue output function 0...10 V, scaled to the measuring range of 0...250 bar. The process connection of the pressure sensor is made via a G 1/4 internal thread.



Figure 16: PA9021 pressure transmitter measuring the hydraulic pressure

Summary

Some information about biogas:

Biogas from 3 tons of liquid/solid manure or 1 ton of organic residues replaces about 120 kWh of current or about 60 litres of heating oil. The output of carbon dioxide is reduced by 200 kg. One cow, for example, produces about 10 to 20 kg of organic waste per day. From this, an amount of 1 to 2 cubic metres of biogas can be produced. The amount of biomass generated by a cow per year more or less corresponds to the energy of 300 litres of heating oil.

Active environmental protection:

Methane, which is contained in biogas and which can affect the climate, must not get into the atmosphere. So, the use of biogas in biogas plants is an active contribution to the purification of the air and so for the minimisation of the greenhouse effect.

Increased efficiency by automation:

Use of the automation system described above with AS-interface components and sensors of ifm electronic does not only offer advantages for the plant builder. Also, the plant is easy to diagnose by the end customer as regards the operation and later maintenance. In case of service interventions, quick and efficient reaction is possible due to the used technology. So, plant downtimes can be minimised.

Profile of ifm electronic gmbh

ifm electronic stands for the optimisation and solution of technical processes by means of sensors, networking and control systems. Close customer contact, quality and innovations have made us the market leader in many areas. Planning and project support make ifm electronic a system supplier on the lower automation level.

Products and systems from ifm electronic

Position sensors and object recognition

Inductive sensors, capacitive sensors, magnetic sensors, cylinder sensors, safety technology, valve sensors, photoelectric sensors, object recognition, encoders

Fluid sensors and diagnostic systems

Level sensors, flow sensors, pressure sensors, temperature sensors, diagnostic systems

Evaluation systems and power supplies

Bus systems

(Communication and control systems for process and industrial applications)

Identification systems

Control systems (controllers for mobile and robust applications)

Connection technology

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If you have any questions regarding this project report or if you are interested in other reports please contact:

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