# Fieldbus technology optimizes sewage treatment

The recently constructed RHV Aschachtal purification plant is a good example of how innovative instrumentation and control systems can help transform sewage into clean water. The fieldbus technology from Siemens and the associated intelligent field devices give this plant a crucial edge over conventional ones. The bus-capable transmitters and electric actuators belonging to the SIPOS family will also enable the purification plant to handle future challenges with ease.

Let's pay a visit to Waizenkirchen, a small town around 40 km from Linz in Austria, where an efficient, modern purification plant tackles the task of treating mainly local sewage from the eleven member communities of Reinhalteverband (RHV) Aschachtal, the local authority association responsible for this area. Designed for a $BSB_5$ load of 25,000 population equivalents and a hydraulic capacity of 325 liters/second, the plant was phased into operation between the fall of 1999 and the spring of 2001.

## State of the art in sewage technology

A glance at the key plant components confirms that only the latest purification plant technology is installed in the sewage line. They include the sewer system with pumping stations and stormwater basins, a supply pumping station, a fine bar screen, a detritor and a presedimentation tank. An anaerobic tank eliminates phosphor biologically and is responsible for upstream denitrification, while two circulating aeration tanks simultaneously nitrify and denitrify with the help of a diffused-air system. Two final sedimentation tanks, a recirculating sludge building with worm pumps and a unit for chemical phosphor elimination round off this section of the plant.

## Ecological benefit: electrical energy from sludge gas

The plant boasts highly efficient equipment not just in the sewage line but also in the sludge treatment section. This equipment includes a mechanical thickening unit for surplus sludge, two gravity thickeners for the primary sludge from the presedimentation tank, two anaerobically heated digestion towers for sludge stabilization and a centrifuge for sludge dewatering. Extraneous sludges and cesspit contents from areas not connected to the sewer system are collected in a separate transfer station.

An engine based cogeneration plant converts the methane gas that is produced in the digestion towers into useful thermal and electrical energy, and is also used for the emergency power supply.

## Sophisticated process control systems to monitor the plant

The plant is controlled and monitored by a process control system with a central programmable controller (PLC) and several partially programmable substations. The most important tasks of the process control system include controlling and monitoring operation, automating process sequences, and documenting and analyzing operating data.

The telecontrol system, which also forms part of the process control system, serves to monitor and control the pumping stations and stormwater basins connected to the sewer system.

Any malfunctions that occur outside normal working hours are notified to the responsible engineer conveniently by means of a modem and voice output. This person can then log into the plant's operator control and monitoring system directly and rectify the majority of faults remotely on the screen without leaving home.

## Operation future: PROFIBUS-DP is the ideal interface

To ensure that sewage treatment is as efficient as possible, all information from

**Fig. 1:** Aschachtal purification plant – the buildings merge harmoniously into the agriculturally dominated surroundings

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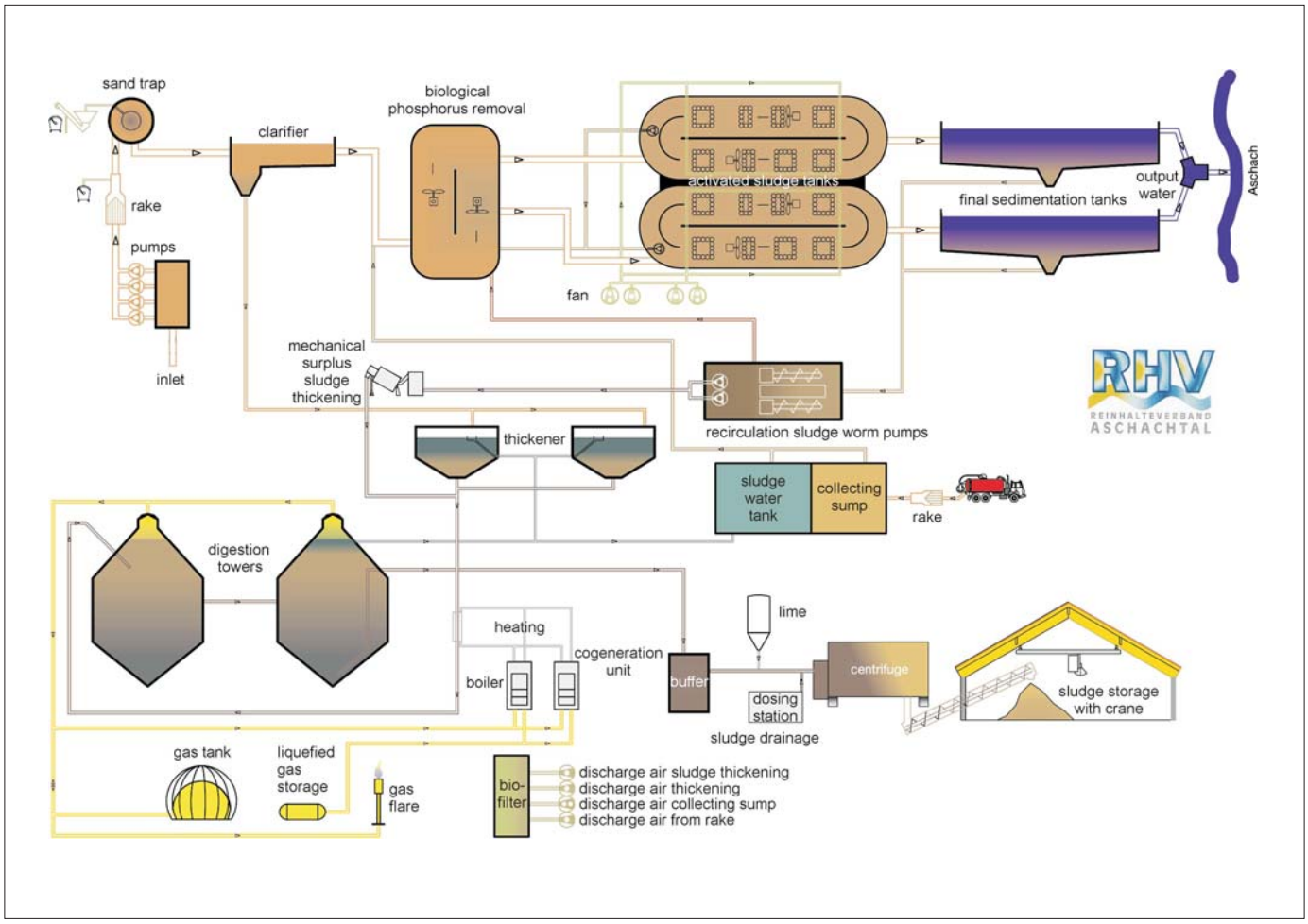


**Fig. 2:** Mimic of the Aschachtal purification plant

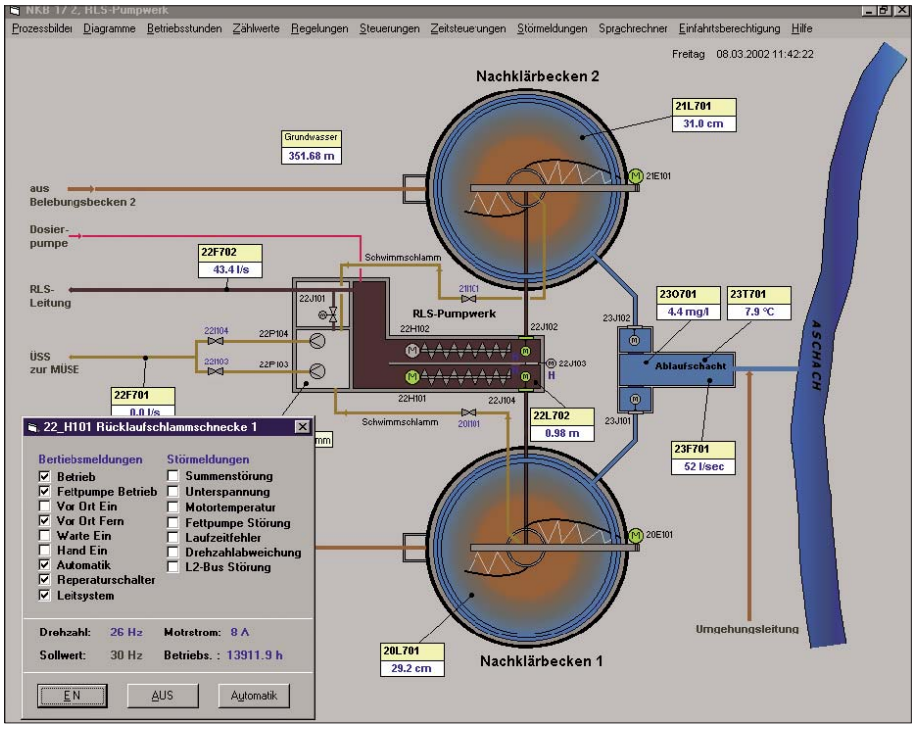


**Fig. 3:** SIMATIC S7-400 operator interface for the final sedimentation tank part with an open window containing information about the status display for the recirculating sludge worm (center)

the various sections of the purification plant initially converges in the control room. The many different parameters are monitored and if necessary corrected. Whereas previously several thick cables were needed to exchange signals, events are now in the capable hands of the innovative PROFIBUS-DP, which transfers all data using only a single thin, two-wire, shielded cable. This modern fieldbus connects the central automation system in the shape of a SIMATIC S7-400 to the switchgear and peripheral equipment. In addition to reducing the number of signal cables and simplifying cable routing, PROFIBUS-DP generates a whole series of other important benefits.

## Bus-capable transmitters connected in seconds

All the peripheral devices are connected in the same, standardized way. Only four terminals – two for the incoming bus cable and two for the outgoing cable – are needed for frequency transmitters, actuators, lower-level PLCs etc. This

considerably cuts the time to connect the equipment, practically eliminates installation errors and significantly shortens the commissioning phase.

And that's not all. Far fewer input and output modules are required on the field device side, creating a lot of extra space in the electronic cabinets. Bus-capable measuring devices that can be parameterized centrally on a PC are hooked up via PROFIBUS-PA and interface modules. The same PC is used to store and read out the parameter settings. If a transmitter is exchanged, the data is simply reloaded onto the new measuring instrument over the bus. What's more, the system can be flexibly extended to take account of changing requirements - another immense advantage.

### Profitable operation thanks to bus-capable SIPOS actuators

One very specific device type is an especially common feature on the bus system: around 90 electric actuators belonging to the SIPOS 5 ECOTRON series perform extremely reliable duty in the purification plant. Their achievement is undeniable.

Although the price of bus-capable actuators is higher than that of conventionally connected devices, the savings they generate are enormous:

- The wiring costs for bus communication are much lower. Since the actuator integrates power electronics (including a frequency converter) and communications electronics components as standard, we can operate 90 % of all devices with a single-phase AC line supply instead of three-phase. On top of this, it was possible in the majority of cases to use smaller conductor cross-sections because high starting currents are prevented by the power electronics. Rotation tests and possible phase corrections are now superfluous.
- Switchgear outgoing feeders and power controllers for the variable-speed drive have been eliminated, enabling the switchgear cabinets to be dispensed with completely. The entire power electronics are now integrated in the actuator.
- The reduction in programming and testing in the higher-level automation system saves engineering costs, because functions such as torque and traveldependent cut-off are now handled by the actuator electronics.
- The integrated local control system allows the valves to be operated locally.

**Fig. 4:** SIPOS actuators – despite exposure to all kinds of weather, these 2SC5 part-turn actuators always supply and discharge reliably

## Enhanced functionality – the bus makes it possible

A cost-benefit comparison has revealed that the PROFIBUS-capable SIPOS actuators offer significantly more functionality for roughly the same money. The spectrum extends from valve position indication and actual motor temperature measurement with a heated motor winding through the recordable motor operating time to the number of switching cycles, cut-offs etc. and parameterizable maintenance limits.

## Actuators as intelligent field devices – a genuine financial gain

As the plant operator, Aschachtal purification plant also profits from the simplification of storekeeping processes and the reduction in the amount of space required. The 90 installed actuators can be subdivided into twelve different types. A mere two electronic units suffice as spare parts. And if ever actuators or valves need to be replaced, this job can be completed in next to no time. The cut-off method, the shifting time and the cut-off torques are easily set using DIP switches and potentiometers. All the other parameters are simply loaded by means of the PC. The settings can moreover be documented, and if necessary duplicated, on this PC – a feature that has proved extremely useful. Should the travel or torque-dependent limit position settings need to be altered, this merely entails approaching the new limit positions and confirming them with the DIP switch. Since the limit switches work electronically, rather than mechanically, they never wear. No maintenance costs whatsoever are generated by the control unit. The driven valves likewise require less maintenance, because they approach the limit positions gently and without any magnification torque.

In the meantime, the purification plant has been operational for more than four years. Reliable processes, impressive functionality and optimum treatment efficiency are its outstanding characteristics. The investment in future-oriented fieldbus technology and intelligent field devices has definitely paid off.