Ethernet-Profibus gateways in the Schwechat Mannswörth wastewater treatment plan enable direct access from the control room to the field devices

Direct to clear water

"Pure water is our goal" – this is the maxim of the Schwechat Wastewater Association in Lower Austria. Increasingly strict legal regulations regarding water quality and the growing volume of wastewater have placed high demands on treatment plant purification systems. There are great challenges facing the technology, the operating processes and, naturally, the experts responsible for them. The following field report describes how gateways connecting Ethernet and Profibus can help increase operational safety and user friendliness while lowering costs.

The Schwechat Wastewater Association is responsible for water purification for 13 local communities and seven large enterprises. In the Schwechat Mannswörth plant – the association's central treatment plant, which has been in operation since 1988 – around 48,000 cubic meters of wastewater are purified each day. This amount can double during rainy weather. The facility is a biological purification plant for carbon degradation and the elimination of nitrogen and phosphorous. The sludge is handled by means of digestion, dewatering and utilization. The backbone of the plant is a 25,000 square meter space containing aeration tanks (35,900 m^3), secondary sedimentation tanks (38,400 m^3), buffer tanks (7,400 m^3), digester towers (8,000 m^3) and gas tanks (800 m^3) with all the necessary electrical, electronic and software-based equipment. The entire treatment plant is monitored and controlled from a central control room using computers. Measurement data is continually recorded from all sections of the plant. In the control room, this data is consolidated, evaluated and archived in accordance with regulations. The control technology system continuously compares the current treatment plant data with the target and threshold values, and it monitors all sub-systems to ensure that they are functioning properly. Discrepancies and error messages are immediately displayed on the screen of the central control computer. This allows operating staff to initiate the necessary preventive or remedial measures before a threshold value is exceeded or a device fails. Furthermore, the redundant layout of the treatment plant guarantees permanent functional security and high availability. An on-call service ensures the ongoing functionality of the entire system throughout the night. The global fieldbus- and Ethernet-based communication infrastructure also makes it possible for configuration data and parameter sets to be easily and reliably transmitted to the field devices distributed throughout the plant. In the early years of the plant, the relatively small number of measurement devices were connected directly (one-to-one) to the process control system via analog cards. Due to a lack of suitable fieldbus technology, this is also how data was usually transmitted in the Mannswörth treatment plant. The wiring necessary for this was very difficult to install, but the system fully satisfied the moderate capacity and quality requirements of the time.

Fieldbuses simplify maintenance

The demands on the technical equipment increased over the years as water quality regulations changed and the volume of wastewater grew. In 1995, the Wastewater Association decided to expand the treatment plant and modernize its measurement and communication technology systems at the same time – namely, by migrating to fieldbus technology. The tasks formerly carried out over the conventional, error-prone cables leading to measuring points, actuators and control drives were taken over by Profibus FMS and DP. Profibus also opened up entirely new opportunities. Among other things, important supplemental measuring points could be set up, particularly in decentralized parts of the plant; much larger amounts of data could be recorded centrally; and the effort involved in installation and maintenance was reduced to a fraction of what it was before. Another of the operator's goals was to be able to service all field devices and drives centrally from the control room over the fieldbus system (i.e., in network segments).

Figur 1: The Schwechat Mannswörth wastewater treatment plant in Lower Austria was established in 1988, modernized in 1995 and most recently equipped with modern Ethernet-Profibus gateways early this year. The field devices can now be configured directly over the data network.

The equipment used

Since the plant was first expanded, it has employed 158 measuring devices for gauging PH levels, O_2 concentration, redox levels, flow rates and fill levels, among other things. These devices are largely connected directly to programmable logic controllers (PLCs) via Profibus DP or FMS. Nine frequency converters are also connected to the same programmable logic controllers (via DP), as are 51 adjustable gate valves and control gate valves (six connected via DP, the majority via FMS). Industrial Ethernet forms the backbone of the network of six programmable logic controllers. This network takes the form of a double ring, thus offering redundancy and a high data throughput rate in multiple respects. One of the programmable logic controllers handles the integration of the central control computer, which exchanges information with the process control system via an OPC connection. Conventional

OPC servers are used for exchanging data between the controllers and the process control system. The "Databridge" software developed by Pickem using development tools from Softing is employed for data communication between the OPC servers. As regards centralized maintenance, the responsible individuals in the Wastewater Association chose to insert an intermediate step, as described above. In 1995, it was not yet possible to provide transparent access from the control room to the field devices via OPC, Ethernet, FMS and DP. The technological gap was too great between the field device level, control level and plant management level. The necessary network gateways, in both hardware and software form, were not available on the market at that time. This is why the Wastewater Association initially chose a different route. The operator provided a centralized PC with a Profibus interface for maintenance work, including device configuration and parameterization. The Profiboard interface card from Softing, which unites FMS and DP on one piece of hardware, was chosen for this. This made it possible to conveniently and reliably configure and parameterize all Profibus field devices with either an FMS or a DP interface from a single workstation. Service technicians were then able to quickly and regularly check field devices and change their settings if necessary. Direct maintenance via Profibus and the Commuwin II configuration tool proved to be particularly helpful when installing or relocating measuring points. The only drawbacks to this intermediate solution were the up to 500-meter-long Profibus lines between the configuration PC and the decentralized Profibus networks, as well as the fact that access was only possible via this single PC.

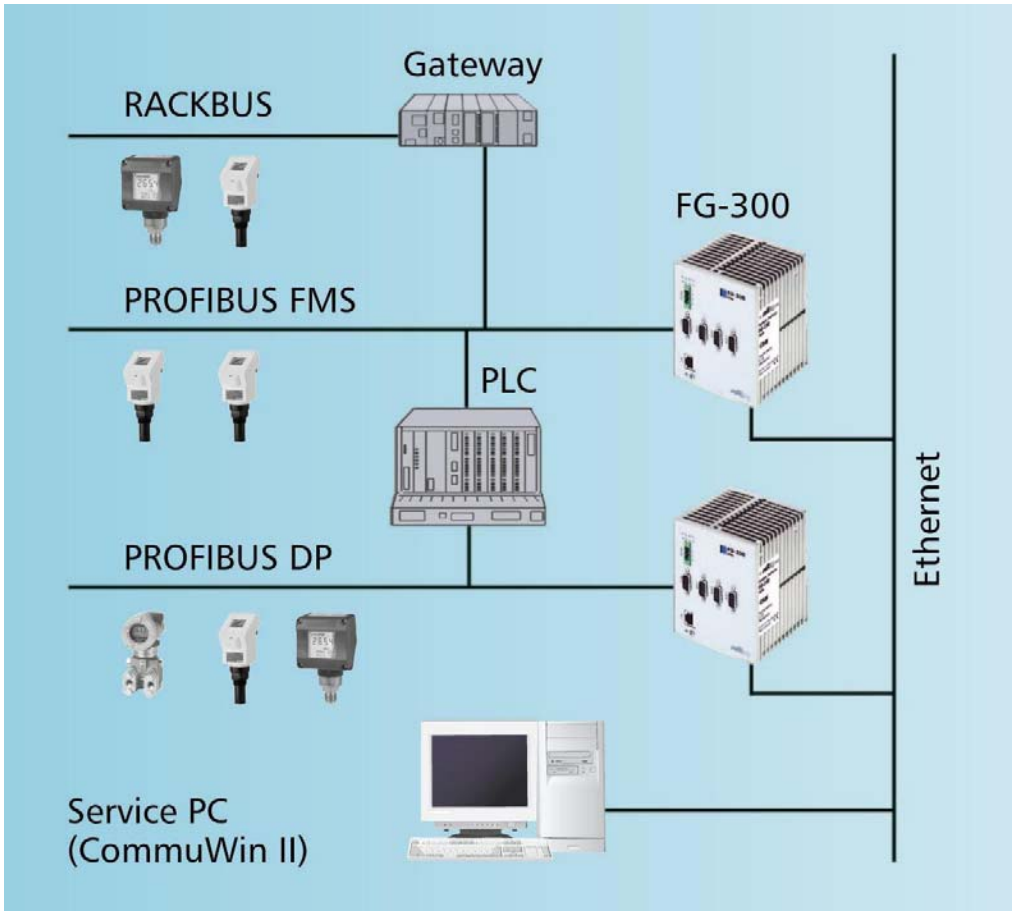
Gateways clear the way for centralized maintenance

These two technical restrictions were completely eliminated by the Wastewater Association at the start of 2004. Field devices can now be configured directly over the data network. This is made possible by the FG-300 Ethernet-Profibus gateways from Softing, which are connected to the Ethernet ring. The FG-300 Profibus gateways link the Ethernet backbone to Profibus FMS and DP. This eliminates the need for the 500-meter-long Profibus lines to the configuration PC. PC workstations linked directly by Ethernet can now gain transparent configuration access to the connected field devices via the FG-300. By integrating Ethernet and Profibus, the FG-300s therefore provide direct access from the control room to the field devices. The Commuwin II configuration tool can still be used as before. The only thing service technicians notice about the new communication paths is that they save time. Technicians can still configure or parameterize field devices as usual using Commuwin II. But one thing has changed for the technicians: Field device maintenance can now be carried out from any PC on the network as long as the configuration software is installed. This has considerably shortened the distance which maintenance staff must cover to reach the devices. If another workstation is needed, it can be easily installed at any time. The migration to gateways was simplified by the fact that each of the eight FG-300s has its own IP address and can therefore be contacted by any maintenance PC via a peer-to-peer connection. The parameters of the gateways themselves can also be changed directly over the network. If the plant is expanded at a later date, any number of additional gateways can be connected to the LAN. Communication between the PC and gateways takes place over the same API (Application Programming Interface) as with the Profiboard used at the beginning. This ensures that the Commuwin II software which was employed up until the migration can continue to be used over the gateways without the need for any additional driver adjustments.

Figur 2: The FG-300 from Softing integrates Profibus and Ethernet via easily accessed interfaces to form a logical network.

Summary

The FG-300 Profibus allows field devices to be parameterized and set-up centrally despite their decentralized arrangement in the treatment plant – almost without leaving the office. The physical distance to the devices in the field no longer plays any role. If the plant is expanded at a later date, extra Profibus networks can be quickly and easily integrated via additional gateways. Centralized maintenance can continue to be carried out in this case. If necessary, additional maintenance PCs can also be installed which can communicate with all gateways without the need for extra fieldbus interface cards – an Ethernet/TCP/IP interface is enough. This means that several maintenance specialists can distribute the work amongst themselves and service the entire system in parallel.



Figur 3: The FG-300 connects the control room and field devices.