

Modernisation of the Municipal Waterworks in Gießen

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Because a new neutralising unit was required, the opportunity was taken to modernise the technical equipment at the Queckborn waterworks belonging to the Stadtwerke Giessen AG (municipal works). In addition to a redundantly structured automation level with embedded control systems interlinked by Ethernet LWL, the HST process-control system HydroDat® V8 was installed. Through the continuous monitoring of the pumping processes, the fully automatic control and automation system makes an essential contribution to supplying the consumers reliably with neutralised water.

The private households and industry in the university town of Giessen are supplied by a waterworks located in Queckborn, a suburb which is about 20 km distant. The reasons for this arrangement are historical because the water rights were sold to the city by the people of Queckborn many years ago. In return, the present-day residents of the suburb receive part of their water supply free of charge. While the main control station is located at the municipal authority in Giessen, three employees carry out the maintenance of the waterworks, wells and overflow shafts in Queckborn. The local control system is used for optimising and operating the waterworks as well as for long-term archiving of data. At the main control station on the other hand, the pumping processes are observed and monitored round the clock. The Queckborn has seven pumping units, of which the three main units are used for supplying the city of Giessen, two for the town of Grünberg, and one each for the towns of Queckborn and Harbach. About 660 m³ of water are pumped every hour, most of which is piped to Giessen by two pipelines.

Neutralisation

The pH value of the water raised in Queckborn does not comply with the requirements of the drinking-water regulations, it was necessary to install a neutralisation plant. It was decided to take the opportunity to modernise the 25-year-old technology of the water works. The local drinking water regulations prescribe a maximum calcite solubility of 5 mg per litre. This is equivalent to a pH value of more than 7.7.

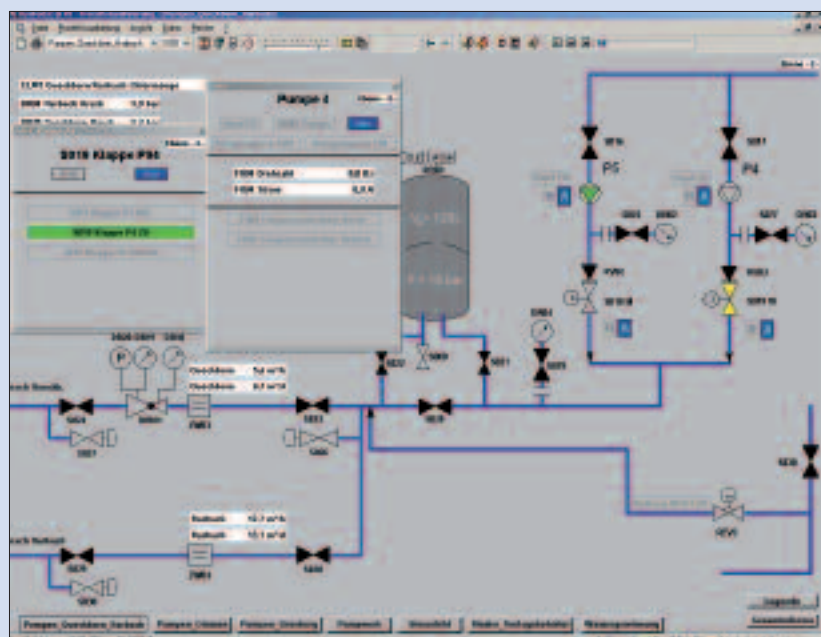
For the purposes of neutralisation, the water pumped from the well is piped from above into two trickling units in which it trickles downwards through the aerators which are designed as filter packs. During this process, the water is aerated from below by speed-controlled ventilators whose air-volume flow depends on the amount of water flowing through. The excess carbon dioxide is expelled by the gas exchange, thereby producing an equilibrium between lime and carbon dioxide. It then flows into a collecting tank from which the neutralised water is pumped to the consumers. According to the employees of the waterworks, the neutralisation capacity is about

80 per cent. Through the treatment, the pH value is increased from 7.3 to 7.8, and the water is enriched with oxygen at the same time.

The Requirements

Water is a basic essential and must be available everywhere at all times. For this reason, the conversion and modernisation work had to take place while the waterworks were in full operation. A further challenge was the fact that the maximum capacity of the collecting tank at the outlet of the trickling units is only 36 m³ and has to be filled and emptied within two minutes. Only 24 m³ of this volume can be used

Convenient operation and observation with the local process-control system HydroDat® V8.





One of the seven wells with pump for raising the raw water.



View of the trickling unit for neutralising the water.

for routine operation. Since no buffer tank is available (and cannot be added) a continuous inflow and outflow of water had to be ensured. If this is not the case, the tank will either overflow or the water supply is jeopardised.

With regard to automation, the municipal authorities had very precise ideas on which components and systems should be used. The control technology had to be programmed according to IEC 61131-3. It had to be possible to parameterise and diagnose all intelligent field apparatus such as frequency converters and process controllers from the main and subsidiary control levels. Instead of a conventional centralised design for the automation system, a distributed control concept was demanded. If every part of the plant has its own independent control system, operating reliability and availability are improved. And finally, the distant ground-water measuring points, wells and overflow shafts had to be remotely controllable via a fixed connection. For the control technology, the only alternative was a system which was in widespread use in the field of water economy, had a large number of references, and permitted a chronological resolution of at least one second for the long-term storage of measured values.

On conclusion of the tendering process and following inspection and careful analysis of reference systems, Passavant & Watec of Aarbergen (Germany) was commissioned to carry out the project.

The Interlink Concept

The automation concept compiled by the Giessen authority consists of the HST TeleMatic monitoring and control system with embedded control systems from Beckhoff, as well as the process-control system HydroDat® V8, both of which are produced by HST Hydro-Systemtechnik. The trickling unit is controlled by the TeleMatic controller SMART-350, while two SMART-350s are provided for controlling the wells and one SMART-350 for linking the waterworks to the main control station in Giessen via a V.24 fixed connection in accordance with the remote-control protocol IEC 60870-5-101. The control units, which are linked to one another and the overriding process-control system by a redundant fibre-optic based Ethernet TCP/IP system, communicate via Profibus DP with the frequency converters, process controllers and E/A modules in the field. Compared to conventional SPC technology, this system is more economical and represents greater safety of investment through its IEC 61131 programming system and open interfaces based on industrial standards.

The transmission line to the main control station in Giessen is also redundant in design. Should the fixed connection fail, an alternative connection is created automatically by Telekom to guarantee maximum availability and reliability of operation. The SMART-350 controllers which are based on the CX 1000 embedded control unit from Beckhoff, are outstanding for their fast regulating times and their variety of standard interfaces. In addition to this,

they are coupled directly to the process-control system HydroDat® V8 and can be programmed and diagnosed directly on site.

The Process-Control System

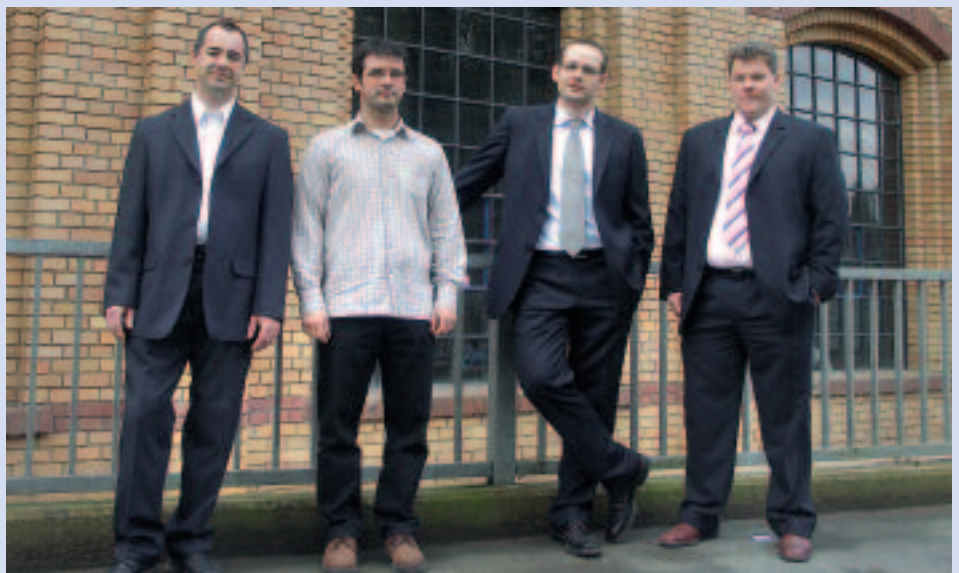
The HydroDat® V8 is a modular-based process-control system for continuous data collection, easy visualisation, convenient processing and comprehensive analysis and documenting of around 3500 process variables. The software permits continuous and economical monitoring of all centralised and decentralised equipment from the control stand in Queckborn. For this purpose, the individual processes are displayed in dynamic images whose information content can be set by the user. The process images and current values can be printed out in graphic form. The visualisation system also allows data to be displayed in tabular form. In case of problems in the waterworks, the maintenance personnel can be alerted by the process-control system. HydroDat® V8 supports all standard alarm types such as telephone, mobile phone, SMS, e-mail or synthetic speech announcement. If the alarm groups or single alarms contain standby plans, the employee concerned is alerted. If he fails to acknowledge the alarm e.g. on his mobile phone, it can be transmitted by another medium or to another employee according to the sequence fixed.

The documentation and analysis of all the process data according to DWA M 260 fulfils not only the statutory requirements, but gives the employees of Giessen municipal works information on weak points and

areas of potential improvement. For example, historical data can be displayed for any period as coloured bar charts, hydrographic curves, dots or spaces. A sum scanner calculates the flow volumes from the recorded hydrographic curves. All analyses carried out can then be saved by user or processed in MS Excel. The Delta-Event-Plus process is used for archiving process data. This enables averages to be calculated for freely selectable periods.

Conclusion

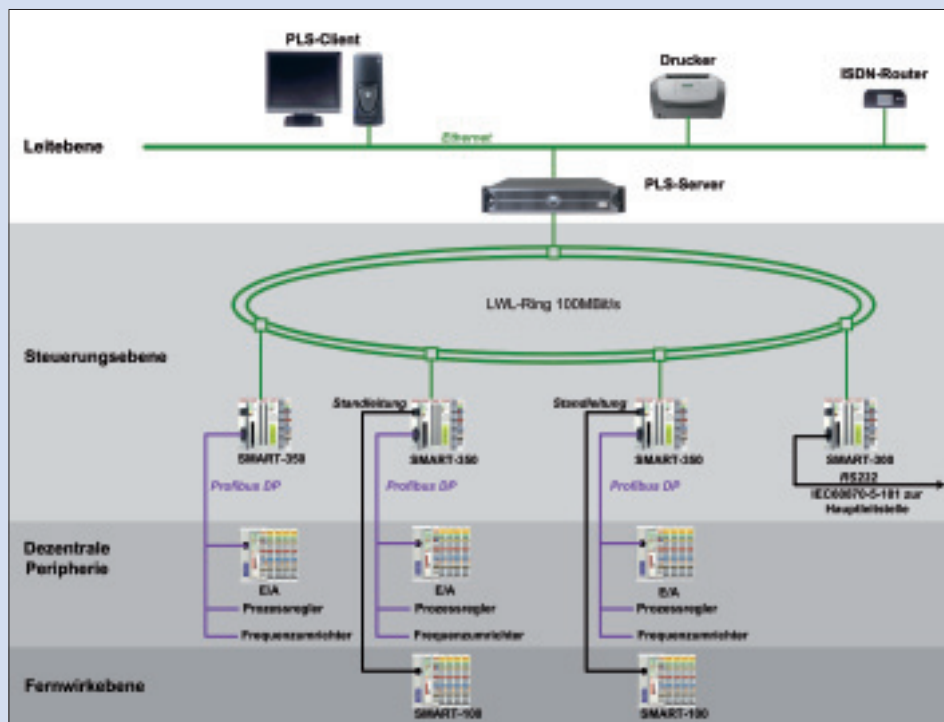
The conversion and modernisation of the Queckborn waterworks took about 6 months. Now that the employees have been working with the new system for about a year, Carsten Schieweck, who was responsible for planning the project, is satisfied with the results. "HydroDat is a complete package designed for water-resource management and allows us to record, analyse and improve our treatment and pumping processes continuously. Along with the redundantly structured automation system with embedded control units, this gives us a high degree of availability and reliability in the water supply as well as being more economical."



Looking back on a successful project: Oliver Felgner (Passvant & Watec GmbH), project leader Carsten Schieweck (Giessen municipal works), Oliver Barwitzki (Beckhoff Automation GmbH) and Ingo Wiesner (HST Hydro-Systemtechnik GmbH).

The Remote-Control Solution

A ground-water measuring point and an overflow shaft situated at a considerable distance from the Queckborn waterworks are linked to the process-control system HydroDat® V8 by the computer-based process-monitoring and control system Tele-Matic. For this purpose, a SMART-100 controller is installed in the external station and transmits the measurement data to the central control and automation system via a fixed connection. It is also planned to include other measurement points using data loggers with GSM or GPRS transmission. Depending on the application requirements, the economical SMART-100 control units can be extended by a maximum of 64 bus clamps with inputs and outputs which are installed directly on the controller. It is coupled to the transmission modem either by an Ethernet interface on the controller or via an RS232 terminal. A separate central remote-control station is no longer necessary. The integrated SPC, which requires about 1.5 ms for 1000 commands, is programmed according to IEC 61131-3. The data-transmission connection also permits remote programming, diagnosing and configuration. This and other features ensure maximum operating reliability and a high degree of efficiency.



System structure of the control and remote-control level.