Efficient Process Optimisation with Hach RTC

Hach Measurement and Control Technology Optimises the Hachenburg Wastewater Treatment Plant

Initial Situation

As part of a refurbishment measure, the Hachenburg wastewater treatment plant invested in the renewal of blowers and aerators. Despite these measures, reliable compliance with the limit values could not be guaranteed with an existing redox control system. To safely comply with the total phosphorus (P_{tot}) permit value, a fixed dosage amount was set. As the plant expected a lower P_{tot} limit value, a more reliable control of the precipitant quantity was required.

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Solution

For optimum control of nutrient elimination, the operations management decided to use Hach **RTC** software modules (**R**eal **T**ime **C**ontrol). The RTC optimisation software is installed on the SC4500 controller, to which the sensors for O_2, NH_4-N, NO_3-N and PO_4-P are also connected. Measurement and control parameters and the RTC controller settings are transferred to the PLC or the control system via PROFINET IO.

Advantages

By using the Hach RTC modules (RTC-N/DN DO), the plant reliably meets the requirements for the outlet values for NH_4-N and total nitrogen (N_{tot}). The load-dependent control of the PO_4-P concentration (RTC-P) enables reliable compliance with the new P_{tot} permit value, which has been reduced by 20%. The consumption of precipitants was reduced by 15%. The entire investment in measurement and control technology could be financed by the refund of the wastewater levy of the last three years. The wastewater levy for P_{tot} is permanently reduced by 20%.

Initial Situation

The Hachenburg wastewater treatment plant is located in Rhineland-Palatinate, Germany and has a capacity of 8,000 population equivalents (PE) (Figure 1). Taking into account the inflowing wastewater from a connected brewery, the load is 13,000 PE. The plant consists of an aeration tank with an internal secondary clarifier. Nitrogen removal is achieved by intermittent denitrification. The wastewater treatment plant discharges into the sensitive receiving waters Nister and Wied.



Figure 1: Hachenburg wastewater treatment plant, Germany

As part of a previous project, upgrades were carried out on the blowers and aerators to comply with the monitoring values for N_{tot} and NH_4-N. However, the existing redox control system could not guarantee reliable compliance with the permit values of N_{tot}=8mg/L and NH_4-N=5mg/L. The P_{tot} permit value is 2mg/L. A mixed product of iron and aluminium is used as a precipitant. To reliably comply with the P permit value, a fixed dosage amount of 6L/h was set. With regard to the P_{tot} parameter, a future reduction of the permit value is expected, as phosphorus is the critical parameter for the receiving waters Nister and Wied.

Solution

To efficiently use the investments for aeration and to increase the operational reliability of nitrogen elimination, the existing redox control system was replaced by the nitrification/denitrification and O_2 controller (RTC-N/DN DO) from Hach.

Based on the continuously measured NH_4-N and NO_3-N concentrations in the aeration tank and the adjustable setpoints for NH_4-N and NO_3-N, the controller decides on the duration of nitrification and denitrification and calculates an O_2 setpoint for nitrification. The O_2 control module determines the required aeration intensity of the blowers for setting the O_2 setpoint.

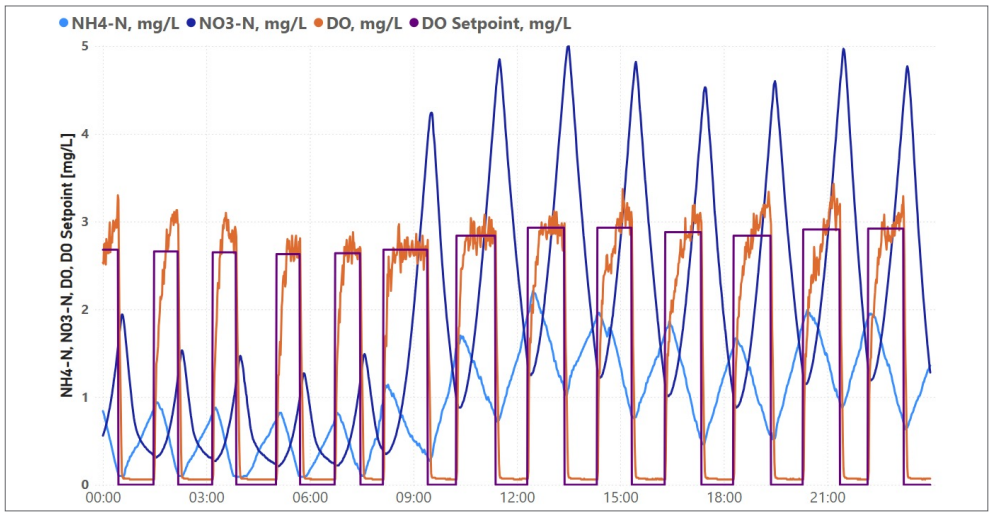


Figure 2: NH_4-N, NO_3-N, O_2, O_2 setpoint

To support denitrification, the nitrification/denitrification controller requests the wastewater from the brewery with a high BOD concentration during denitrification.

Figure 2 shows a typical curve for NH4-N, NO_3-N, O_2 and O_2 setpoint with variable times for nitrification and denitrification. At low load at night, the nitrification/denitrification controller sets shorter nitrification times and calculates a lower O_2 setpoint.

The NO_3-N and NH_4-N concentrations fluctuate around the setpoints. With this control system, compliance with the permit parameters NH_4-N and N_{tot} can be ensured.

To upgrade the chemical P elimination, the phosphate controller (RTC-P) from Hach is used, which controls the continuously measured PO_4-P concentration in the outlet of the aeration tank to a desired PO_4-P setpoint by means of a PO_4-P load-dependent dosage of the precipitant into the return sludge.

In addition, if a certain PO_4-P concentration is exceeded during denitrification, the RTC-P transmits a signal to the RTC-N/DN DO to terminate denitrification in order to limit P release back into solution.

By using the RTC-P, the minimum precipitant dosage amount could be reduced from 6L/h to 2L/h and the total precipitant consumption by 15%. In addition, reliable compliance with the setpoint for the PO_4-P concentration in the aeration tank outlet is guaranteed.

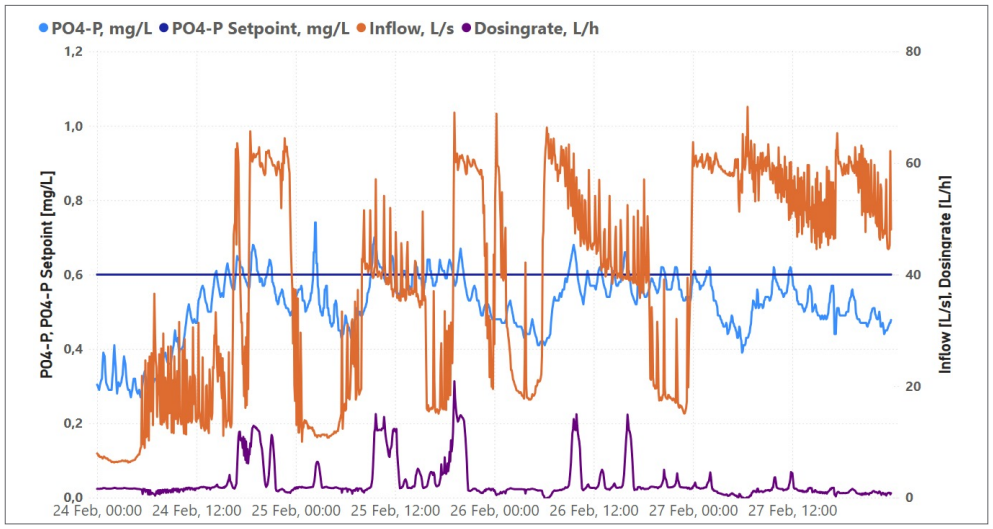


Figure 3: PO_4-P, PO_4-P setpoint, dosage rate, inflow volume flow



Figure 4: Operation of the HACH RTC via the sc4500 transmitter and via the control system (FlowChief)

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The RTC-N/DN DO controller and the RTC-P are installed on the Hach SC4500 transmitter, to which the devices for measuring the O_2, NH_4-N, NO_3-N and PO_4-P concentrations are also connected (Figure 4).

In addition to the sensor signals, the SC4500 also transmits the suggested setpoints:

- to activate nitrification or denitrification,
- for the aeration intensity
- for the dosage amount of the precipitant

to the PLC. The digital communication between the SC4500 and the PLC takes place via Profinet.

Setpoint changes for the NH_4-N, NO_3-N, PO_4-P concentrations and changes to the control parameters can be made

- on site at the transmitter at the aeration tank or
- from the plant's control system or
- remotely via the Hach Claros Mobile Sensor Management System

All settings are continuously synchronised (Figure 4).

Hachenburg WWTP Installation Overview

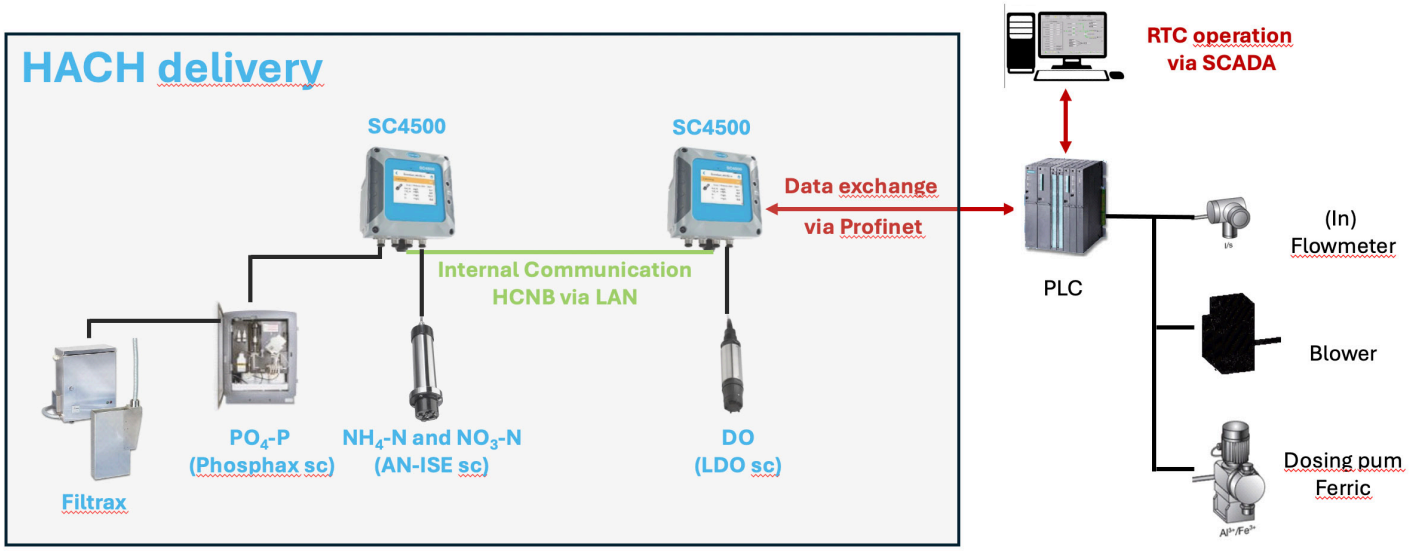


Figure 5: Installation overview

The communication protocol between the Hach SC4500 transmitter and the PLC is Profinet IO. The integration of the SC4500 signals was carried out by the local system integrator with little effort (Figure 5).

Conclusion

By implementing the Hach control modules and the corresponding instrumentation (Figure 5), the process stability for nitrogen and phosphorus removal could be increased. The consumption of precipitants was reduced by 15%.

By reliably controlling the PO_4-P concentration, the P_{tot} monitoring value could be reduced by 20%. This enabled financing of the investments for instrumentation, control and system integration through the refund of the wastewater levy of the last three years. In addition, there is a permanent reduction of the wastewater levy for the P_{tot} parameter by 20%.

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